THE

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THE

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1900

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NAVAL BOILERS.

THE bringing forward of the Naval Estimates has brought up the question of the Belleville boiler once again, and at last our contemporary, the *Engineer*, does not unreservedly back up the policy of the Admiralty, as it did—hastily in our opinion—after the *Terrible* and *Powerful* had been proved capable of running a few hours without breaking down when in charge of a veritable army of engineers. Our contemporary now asks that those who have condemned the Belleville boiler should propose a substitute, and lays down the law in very dictatorial style to the effect that it is but a waste of time to advocate the Scotch boiler for our navy. But our contemporary is singularly inconsistent. While preaching on the 50 per cent. more heating surface in the water-tube boiler, the writer appears to be making a great fuss over a gnat and yet calmly swallows an economiser camel, for with all the extra heating surface the Belleville boilers appear to require an economiser perched high up in reach of the enemy's guns.

Assuming that the water-tube boiler uses about one-third more coal than the Scotch boiler, it remains to be shown where the latter is at a disadvantage when it comes to long voyages. Any difference in weight will soon be made up by the increased coal necessary to steam a given distance. It is not as the *Engineer* states, a question of the gross weight of machinery, coal and water. The coal cannot be a constant when one boiler is less efficient than the other.

Admitting that there are conditions that render the water-tube boiler necessary or desirable in some or even in all ships, it does not follow that so ill-considered and costly an experiment as the equipment of our finest cruisers should have been carried out as it has been. It is the Belleville boiler to which we more particularly object, and very largely, because the tubes of this boiler are in series from bottom to top of each vertical element; moreover, they are flatly inclined, or nearly so, and we fail entirely to see how it is possible for satisfactory circulation to be kept up over a fierce fire.

All the experience that is available points to this same conclusion. We may admit, and freely, all that is claimed as to the wider limits of area of grate surface possible with water-tube as with all externally fired boilers. Though it is late in the day, it is satisfactory to find the *Engineer* now has doubts of the Belleville type, which it admits to have been disastrously uneconomical previous to the addition of the economiser. We regret that these were not plainly stated at the outset. A little consideration of the detailed arrangements of the Belleville boiler ought to have sufficed for this. There could not but be doubts as to the risks that were run. We had very strong ones, and expressed them at the time. We were unfortunately quite alone in our condemnation of the colossal experiment. The information at our disposal was only that at the disposal of everyone else, and the too favourable description of the cruisers'

trials, without a hitch, was swallowed whole. Mr. Allan, of Gateshead, has persistently opposed the boiler policy of the Admiralty, and other members have asked questions and received more or less inadequate replies, we will not call them answers. Mr. Goschen says we are only following France, Germany, Russia and America. A pretty pass we have arrived at that the British navy must servilely copy foreign practice! As pointed out, however, America is far more likely to adopt the Babcock type of boiler than the Belleville, while it does not really matter two pins to the other three countries whether they have so very excellent a fleet or only an ordinary one. The Dutch, who alone have ever seriously rivalled us at sea, have adopted an English boiler, the Yarrow. The *Engineer* can now admit that the *Diadem* has staggered feebly from port to port. All know the failure of the *Powerful*. It is admitted that the Belleville boiler suffers terribly from pitting and wasting.

Our contemporary as much as hints that the desire of engineers at sea to appear to be keeping their machinery in order is responsible for Sir John Durston being kept in ignorance of the real state of affairs, in common with the home staff generally. Sir John Durston is usually considered to be responsible for the wholesale introduction of the Belleville boiler into the British navy before any good record could be produced from it. Even M. Bertin, of the French navy, cannot or does not make a plain statement of any excellence to be attributed to the boiler. The truth appears now to be slowly coming out. As Mr. Allan says, we have but a paper fleet so far as it is steamed by Belleville boilers. It is a pity the *Engineer* did not have the courage at the outset to utter a note of warning such as an examination of the arrangements of the Belleville boiler would have prompted anyone to sound who knew anything of boilers. Water-tube boilers have never been noted for their safety as a class, but we would not condemn them all. There are types other than the Belleville—types in which provision is made for circulation. We think it every man's duty at the present juncture to insist on an inquiry into the boiler policy of our navy. We feel sure the present policy has the approval of the Continent.

Economy of Mechanical Draught.

WHY are engineers so slow to adopt mechanical draught when by doing so they could at once save the heavy first cost of a chimney? Especially in electrical works ought mechanical draught to be employed. A small plant is put down, and a chimney of suitable size. If the business proves successful, an extension is very quickly required, and the engineer is then face to face with two difficulties. Either he must go on with a bad and inefficient draught, or he must build a second chimney. This second chimney is thoroughly in the way. It is difficult to say how big it must be, and the engineer must either risk making too small a chimney—one that will not endure above four or five years—or he must lock up a heap of capital in a chimney that may be too big for ever after. Especially at the beginning of an electrical works, be it a tramway or a lighting station, we should judge it wise to put down a fan. If this becomes inadequate, a bigger one can be put down. Fans are neither heavy nor expensive. There ought to be a good business done in second-hand fans in a few years, for a newly started station would soon outgrow its fan and dispose of it to a still newer place, and itself acquire a larger one. The earliest fan installation of which we have any knowledge, had a fan to each boiler. The system is worth consideration, especially now that electric driving is so convenient of application, though this is one of the instances where possibly the fans would be better driven by a shaft than directly from the motor. Separate fans placed at the back of the boilers are exposed to a higher temperature than a single large fan placed between the economiser and the chimney, and this may be a disadvantage weighing against the system of one boiler, one fan, but the system has a sort of finality about it—each boiler is complete in itself. Mr. Snow, who is connected with the Sturtevant Company in America, may be an interested witness, but he is at least an expert in fan draught, and he says that with a plant of 2,400 H.P. fitted with economisers there will be saving in first cost of nearly £1,300 on a total of nearly £16,000 by the use of mechanical as against chimney draught. When a chimney may cost £4,000, this is easy to understand. But, further, the use of the fan permits thicker fires and better combustion, so that boilers of 2,000 H.P. will do as much as 2,400 H.P. of ordinary boilers with equal economy, or a further saving may be made in a carefully designed plant of one-sixth of the boiler first cost. Still, it is not to be supposed that it is to the interest on this reduced first cost that engineers need look to pay the cost of running the fan. This can be more than paid for over and over again by the power it gives of using inferior fuels, and there still remains the legitimate saving due to the abstraction of more heat from the gases now no longer necessarily hot. By extended feed water and air heaters, Mr. Snow claims that only 5 per cent. of the heat generated in the furnace need be thrown away. Beyond all this there remains the elasticity in working, the peace of mind should a fog descend, when a few more turns of the fan urge fires to their best, which would otherwise go to their worst on a heavy foggy day. Fog is the cause of enormous demand for current in a light station, and it also increases the current consumed per car mile in tramways—probably because it involves such frequent stops and starts through caution against collisions. Undoubtedly engineers ought to look into the matter for themselves.

Our Patent Laws.

WE have received from Mr. James Keith, C.E., a pamphlet in which he points out the defects of our Patent Laws. His principal objection is to the renewal fees. In the United States a patent lasting 17 years costs in Government fees £7; in this country we have to pay £99 for 14 years. We should expect that the British patent would be more valuable since it costs so much more, but the contrary is the case, since the British Patent Office takes no trouble to ascertain whether the invention is new, whereas the American patent is only granted after having been subjected to a severe examination for novelty. Mr. Keith estimates that if all the renewal fees after the initial payment of £4 were dropped, the Patent Office would still probably have a small surplus. If the fee were made £7 as in America, the funds would be sufficient to pay for an examination for novelty. We agree, generally, with Mr. Keith's views, but in making the comparison between the cost of an American and a British patent, he forgets that a British patent usually is split up into several American patents, owing to the fact that the scope of a single invention is much more restricted in America than here. Cases have been known in which it was necessary to take out 17 American patents to cover what was included in a single British patent. An examination of patents for novelty would, we believe, be in the interest both of the public and of the patentee; but the greatest opposition has hitherto been offered to this amendment of our law, and we hope that the opinion expressed on the subject by Mr. Keith is a sign that more enlightened views are beginning to prevail.

ON ELECTRIC LIGHTING CABLE BREAKDOWNS.*

(*Concluded from page* 383.)

If we now consider the second case, which was referred to above under heading (*b*), in which the outer conductor, disconnected at one end, forms one side of a mesh of the town network, we see at once that the danger is considerably less. So many unfavourable conditions must arise simultaneously, that the probability of danger is considerably lessened; this is confirmed by experience. Cable breakdowns caused by faulty switching in and out occur in general far less frequently in the inter-connected portions of the network than in the feeders. The peculiarity of a cable forming one branch (or side) of a mesh is, that both ends are connected not only with transformers, but also with other branches, so that there are always at least two paths for the current back to the central station.

Hence if, say, the outer conductor is interrupted in the neighbourhood of the transformer A, since the connection with the transformer, B, still exists, and also with other cables, B D, D E, and so on back to the central station, a dangerous state of things is not brought about, for so long as the above connections remain intact, the voltage of the outer conductor is linked with the bus bar voltage in the central station, which remains constant on account of the small inductance of the generators.

For a dangerous condition to arise, the outer conductor must be interrupted at two places, and further, at least one transformer must be connected with the portion of outer conductor thus isolated from the rest of the network. This, however, is still insufficient, for as long as the secondary coil of the transformer remains connected to the secondary network, it is impossible for the voltage to differ much from the normal value and the transformer shares the load with all the others in the whole town district.

It is scarcely possible that this can fall quite to zero at any moment on account of the widespread utilisation of the current. In the worst case a minimum load of one-tenth might be reached, which corresponds, as we see from fig. 4, to a voltage of 3,500 on the outer conductor with a terminal voltage of 3,000, the capacity being 0·86. Hence this case can scarcely be considered dangerous. There is, in fact, no danger, unless the transformer secondary be switched out, when the rise of voltage on the outer is that represented by the curve in fig. 3. It is, of course, possible, that all the above-mentioned conditions should simultaneously arise, but it is hardly probable, and this explains the fact stated before of the comparatively small danger in network branches compared with feeders.

The examples already dealt with, as stated at the beginning, depend on resonance, and have been discussed by various writers, although more theoretically than practically. It has generally been considered sufficient to demonstrate how a rise of voltage may be occasioned by resonance; I, however, have here attempted to arrive at the extent of the danger in a given practical case. The means for avoiding it when concentric cables are employed are, first, the strict adherence to Neufeld's rule for switching in and out; secondly, the earthing of the outer conductor at some point, and thirdly, the omission of all fuses in the outer conductor.

Now cable breakdowns frequently occur which are not the result of interruption of the outer conductor but of an earth in the inner conductor. Such cases are not treated or even mentioned, as far as I am aware, in the literature on the subject, but are generally of a much more serious nature than those discussed above, since, should the inner conductor become earthed, the insulation of the network gives way in several places simultaneously, which naturally causes a much greater interruption of the supply than does the disabling of a feeder (or perhaps, occasionally a piece of the cable of the network) through faulty switching in or out.

As far as I am aware, this kind of cable breakdown has only been observed hitherto in town networks consisting of concentric cables, and where, on the one hand, all the primary and, on the other, all the secondary mains constitute interconnected networks; but they have not occurred in installations where solitary transformers are employed.

If we are, therefore, to seek an explanation of this phenomenon, we must bear in mind the fact that one of the conditions of a dangerous rise of voltage on the outer conductor is the existence of an interconnected secondary network, and that the critical points are not only, and, indeed, not chiefly to be found in the feeders, but just as much in the interconnected primary network. The occurrence is, however, always consequent upon an earth in an inner conductor.

In fig. 6, P and S represent the primary and secondary coils of a transformer in a sub-station. I is the inner and O the outer conductor of the feeder leading to this sub-station, which latter is connected with other sub-stations by means of primary cables. I_1 represents all the inner and O_1 all the

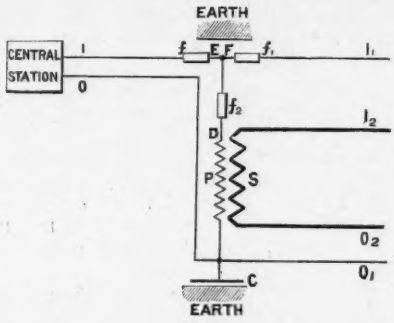


Fig. 6.

outer conductors of these connecting cables. The remaining sub-stations are not shown in the figure; feeders run from the central stations to some or all of these. I_2 O_2 are the inner and outer conductors of the secondary distributing cables which run to the neighbouring sub-stations. If I be interrupted purposely or by the fuse (f) going, the voltage across P will not thereby be reduced to zero, since it still derives its voltage from other feeders *viâ* I_1. Even if f and f_1 melt, the voltage across P still does not disappear, for it then derives its voltage from the secondary winding, S, which is fed from other sub-stations by means of the mains, I_2 and O_2. The connections of both the primary and secondary must be interrupted in order that the voltage across P shall be reduced to zero.

Let us suppose that an earth occurs at D, for example, at the leading-in gland of the transformer; the fuses f, f_2 and f_1 will then melt. It is immaterial which fuse goes first, for the earth still remains after they have melted. The current supply to the transformer is now *viâ* the secondary, the primary is converted into a source of alternating E.M.F., and is possessed of inductance and resistance. The path of the current is now as follows:—From the "earth" depicted on the upper side of the diagram (equivalent to the lead sheathing of the whole network of cable) to D, thence to O_1 *viâ* P and through C, the capacity of all the outer conductors to lead, to the "earth" at the foot of the diagram. It must be noted that the inductance is now much smaller than in the above-mentioned cases, for it is due only to the magnetic leakage of the transformer. On the other hand, the capacity is now much greater, viz, that of the whole cable network. Resonance can therefore occur, and consequently, any part of the whole network is liable to breakdown. Whether this be the case or not depends on the secondary load and on the proportioning of the fuses. If the load be very great, and if the fuses of I_2 O_2 be of proportionately small carrying capacity, it is conceivable that the current through S may be already interrupted before the fuses, f_2 and f_1, go, whereby, of course, all danger is avoided.

The probability that the secondary fuses will melt quickly is naturally increased by heavy local load, and thus we see that the magnitude and distribution of the load of the secondary network influences the danger of a breakdown. As it is practically impossible to adjust fuses with the necessary exactitude, it is useless to look for protection in this way. One might, no doubt, argue that an exact adjust-

* Translation, by M. B. Field, of article entitled "Ueber Kabeldurchschläge," by Gisbert Kapp (*Electrotechnische Zeitschrift*, December 28th, 1899).

ment of the fuses is not necessary since, as it is a case of an earth in P, corresponding to a short circuit in S, the fuses in I_2 O_2 cannot fail to melt. They do so, in fact, only they require a certain time for it. If w be the resistance of the fusible strip, i the current, T the melting temperature, c a constant depending on the thermal capacity and on the terminals of the strip, and k a coefficient depending on the cooling facilities, the interval of time from the short circuit till the current is interrupted is given by

$$t = -2{\cdot}3\,\frac{c}{k}\,\log\left(1 - \frac{k\,T}{w\,i^2}\right).$$

I will not here enter upon any digression on this formula, as it would too much enlarge the scope of the present article. Further, great exactness in the determination of t is unnecessary, for it is sufficient if we know whether t be at all greater than the time occupied by a few cycles.

An approximate calculation shows that a fuse that melts in 100 seconds with double the normal current (one would not dare to employ a smaller fuse from practical considerations) requires 0·7 seconds to melt with 20 times the normal current, and 0·13 seconds with 50 to 60 times the normal current. Hence in this extreme case six periods would elapse before the interruption of the current, which is fully sufficient to bring about the mischief. We can therefore say that fuses are useless as protection against breakdowns. This, of course, also holds for the fuse f_2. We have hitherto assumed that the earth occurs in D, fig. 6; its occurrence, however, on the far side of this fuse, say, at E or F, so long as f and f_1 melt before f_2, would afford us no protection against the occurrence of resonance phenomena.

The above considerations show that resonance effects can occur in spite of the insertion of fuses in the inner conductor and their omission from the outer conductor, the only question is whether these effects be dangerous. In order to arrive at an answer to this question, we will investigate the former example of a town network having a total capacity between outers and earth of 100 microfarads, where we assumed the transformer to have an output of 20 kilovolt-amperes.

The core loss was, at normal voltage, 300 watts, and we may put down the copper loss, at full load, likewise at 300 watts, the ohmic drop being, therefore, 1½ per cent. Let the inductive drop be 4 per cent.

Denoting these in terms of the primary voltage, we have on full load

$$e_R = R\ 6{\cdot}7 = 45.$$

$$e_s = \omega L\ 6{\cdot}7 = 120.$$

$$e = \sqrt{45^2 + 120^2} = 128.$$

If we, therefore, supply to the secondary terminals current at a voltage of $100\,\frac{128}{3{,}000} = 4{\cdot}26$ per cent. of the normal secondary voltage, we shall have the full load current in the short-circuited primary coil.

The larger the transformer, the smaller will be the resistance and inductance, and these quantities may be considered, within reasonable limits, as inversely proportional to the output. If P be the output in kilovolt-amperes, we have generally

$$R = \frac{134}{P}$$

$$\omega L = \frac{360}{P}$$

where R and ω L represent that primary resistance and inductance which would correspond to the total resistance and inductance of the whole transformer.

Let us now assume that the earth in the inner conductor occurs in the immediate neighbourhood of a transformer of which P = 20. In order to find the voltage between the outer conductor and earth, we proceed as follows:—We assume an arbitrary charging current, for example, 40 amperes, the watt component is

$$40 \cdot \frac{45}{128} = 14,$$

and the wattless component is

$$40 \cdot \frac{120}{128} = 37{\cdot}5.$$

In fig. 7 O A = 37·5, A B = 14, O B = 40; the terminal voltage must be at right angles to O A, the magnitude of the same being determined by the expression

$$e = 128\,\frac{40}{6\,7}$$

or e = 764 volts, the effect of the core loss being neglected on account of its small magnitude. We thus arrive at the vector of the terminal voltage O D = 764. A voltage determined by the expression

$$i = \omega\, C e\, 10^{-6}$$

or 1,420 volts, is required to send this charging current of 40 amperes into the condenser. We drop, therefore, a perpendicular on O B and make O E = 1,420. D E or 750

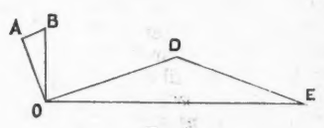
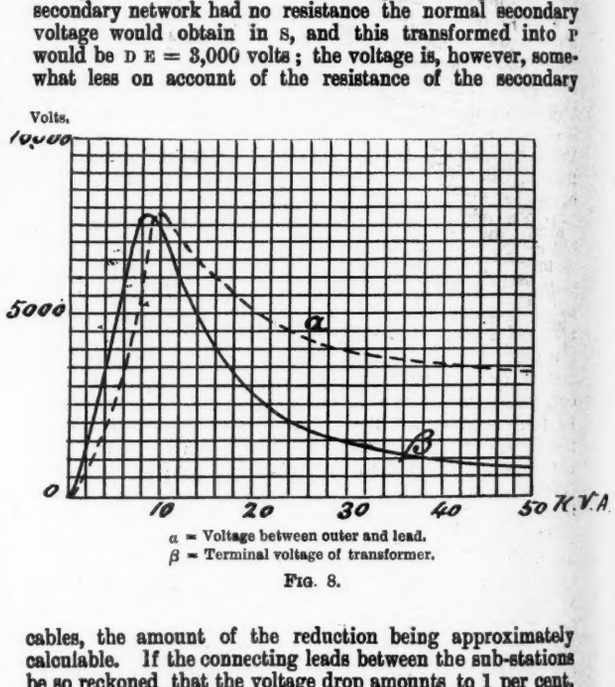


Fig. 7.

volts is consequently the voltage which must be supplied to the combination of transformer and cable network in order that the assumed current of 40 amperes may flow. Now, as a matter of fact, the coil, P, is not supplied at a voltage of 750, but at a much higher voltage. If the secondary network had no resistance the normal secondary voltage would obtain in S, and this transformed into P would be D E = 3,000 volts; the voltage is, however, somewhat less on account of the resistance of the secondary



α = Voltage between outer and lead.
β = Terminal voltage of transformer.

Fig. 8.

cables, the amount of the reduction being approximately calculable. If the connecting leads between the sub-stations be so reckoned that the voltage drop amounts to 1 per cent. and three other sub-stations be in connection with the one under consideration, the transformer would be fed through three cables, and the loss at full load or a primary current of 6·7 amperes would be only ⅓ per cent. Now the load is not 6·7 amperes, but approximately

$$40 \cdot \frac{3{,}000}{750} = 160\ \text{A},$$

and the loss is consequently

$$\tfrac{1}{3} \cdot \frac{160}{6\,7} = 8 \text{ per cent.}$$

The voltage supplied is, therefore, 3,000 × 0 92 = 2,760 v. Hence the arbitrary assumption of i = 40 amperes was evidently not the correct one, the correct values for current and voltage are, however, very easily found from fig. 7; we need only change the scale of the same in such a way that D E measures to the new scale 2,760 volts. The multiplying factor is, therefore,

$$\frac{2{,}760}{750} = 3{\cdot}68,$$

and the outer voltage will be $3 \cdot 68 \times 1,420 = 5,220$ volts, the terminal voltage will be 2,800 and the current 147 amperes, *i.e.*, 22 times the full-load current. Roughly, 25 complete periods will elapse before the fuses melt in consequence of this current; there is therefore quite sufficient time for the insulation of the outer conductor to be broken down simultaneously at several places by this voltage of 5,220.

A similar occurrence can take place with multiple core cables, but the danger is in that case not nearly so great. The cable network would have to be extended to about 500 kilometres, in order to have the same capacity, and then the resistance of the connecting cables would of itself reduce the tension, besides which much larger transformers would be employed, of which the inductance would be considerably less.

A network comprising 100 kilometres would have a capacity of the order of 20 microfarads, and if the calculation described above be carried out for this case, combined with a 20-K.W. transformer, it appears that the charging current amounts to 10 amperes, and the voltage roughly only to 3,000, at which the danger of breakdowns is not incurred. Either the supply voltage would have to be considerably over 3,000, or the size of the transformer materially lessened before this could occur. The curve in fig. 8, representing the voltage of the outer conductor for different sized transformers, can be calculated, as shown above, for a network consisting of concentric cable; we have thus a curve representing the danger of a breakdown as a function of the size of the sub-station.

From this it is obvious that there is no danger with either very small or very large transformers. If we consider, as before, 5,000 volts between outer conductor and lead to be the dangerous limit, we see that all sub-stations with transformers of above 7 and under 22 K.W. output are inadmissible. It would, however, be advisable to somewhat increase these limits, since the method developed above for the determination of the same cannot lay claim to very great accuracy. We have, in fact, made certain assumptions, which are not altogether warrantable, in order to arrive at a treatment which shall be both simple and clear. For example, the resistance, and in all probability the inductance, have different values for very large short circuit currents from what they have with low currents. Further, the resistance of the connecting cables was merely guessed at random without taking into consideration the current density and so on with other points.

Since, however, we cannot be certain that 5,000 volts is exactly the dangerous limit for the outer conductor, an exact calculation taking into consideration all these factors would be of no practical use. We see, moreover, from fig. 8, that a slight variation in this value means a great variation in the dangerous output of the transformers; it is, therefore, useless to determine the latter with painful accuracy.

One method only is effectual if it be desired to really protect the network from the above discussed phenomena, viz., the earthing of the outer conductor. This can, of course, only be done at one point, on account of the telephone disturbances which would otherwise arise; one point, however, will be sufficient, if at the same time all fuses be omitted from the outer conductors. A non-inductive resistance may advantageously be inserted in the earth connection, so that if an earth occur on the inner conductor, the current rush will not be greater than is necessary to melt the particular inner conductor fuse.

Now, there is no outer conductor with multiple core cables, and protection by means of earthing is not feasible. Happily, however, multiple core cables, whether for single or polyphase currents, have a much smaller capacity than concentric cables, and the danger will be, therefore, so far remote that in ordinary town networks it will, of itself and without further precaution, be eliminated.

In general it will be advantageous to avoid choosing an unnecessarily high supply voltage, since the phenomena here discussed in each case pass into the dangerous region on account of a too great charging current—never the reverse. A particularly small copper and core loss in the transformer increases the danger, but not nearly to the same extent as a large no-load current and large inductive drop would, so that one should in this connection, first of all, direct one's attention to securing the most favourable design of transformers possible. With networks consisting of multiple core cables, each end of a conductor should be provided with a fuse; that at the central station end, however, should be larger than that at the far end, and further, one should avoid too small transformers for use on interconnected networks. When using concentric cables, one should omit all fuses from the outer conductor, and with interconnected networks, one point in the system of outer-conductors should be earthed through a resistance.

THE DIFFICULTIES OF SUPPLYING ELECTRICITY.

[COMMUNICATED.]

The word nuisance must have been freely applied to electrical undertakings during the past few months. There is the nuisance of the lights being low, the nuisance of the supply completely failing, and the nuisances arising from vibration and smoke.

Obviously the two latter are the most serious, and each might be responsible for the closing down of works. There are many electricity works in the metropolis that have fallen under the ban of the non-smokers, and each prosecution they have engineered has been followed by an exemplary fine. While police-court fines might be borne with a certain degree of fortitude—especially if the saving effected between low-class and high-class fuels covers the fines—the matter would be wholly different were it brought before the High Court. Under such circumstances the plaintiff would apply for damages and perpetual injunction, and there is always the possibility of an electricity supply being shut down by order of the Court. Then there might follow actions by consumers for damages caused by the cessation of supply, and altogether it is conceivable that conditions might arise under which the lot of a supply company, like that of a policeman, would not be a happy one.

The history of electricity supply is not a long one, but it has been fairly crowded with incidents, and not the least interesting are those arising under actions for nuisance. In London there is always the chance of a claim being set up for a vibratory nuisance. It makes no difference if electricity works be first erected and a speculative builder comes along and erects some flats close by; if nuisance can be proved, the works may be compelled to close at any moment. Therefore, the question in the metropolis is not whether the generating machinery is well situated as regards economy of distribution and convenience for obtaining water and coal, but whether it would be likely to create what some would term a nuisance. Not for a moment do we wish to minimise the evil effects of vibrations; on some constitutions they might work disastrous results, but it is so easy to magnify and amplify vibrations, especially when they are caused by rich companies. There is ample evidence that some of the London companies have caused serious damage to surrounding property, and that no doubt accounts for the fact that most of them are fairly large property owners. Still, there has been a strong disposition on the part of many people to credit electrical works with more than their due.

There is a well-known instance in West London, where a householder made strong complaints of vibration against a supply company whose works were 150 yards away; on investigation, however, it was ascertained that the underground railway passed under the very roadway in which the irate householder resided. Two cases of imaginary nuisance were recorded in Mr. Alfred Roberts' paper on the "Designing of Electrical Generating Stations," given in a recent issue. In one the property owners brought an action for damages in respect of vibration; they stated that they had kept a careful note of the times when the vibration complained of was extremely bad, and yet it was conclusively shown that the worst period was when the company in question were not running any engines at all. Another instance arose in the centre of a residential neighbourhood regarding the chimney shaft of an electricity works. When the complaint was made it was proved that the works were entirely disused, the plant and boilers having been removed to another site.

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$40 : \frac{120}{128} = 37{\cdot}5.$ $\frac{2,760}{750} = 3{\cdot}68,$

These clearly demonstrate that there is a good deal of exaggeration on the subject of nuisance.

Some days ago a very important action was before the Courts, and the decision shows clearly enough that whoever are the owners of electricity works, and whatever inconvenience may arise to consumers, if the facts regarding nuisance can be established there must be an immediate abatement or the works will have to be closed. The case alluded to possesses some curious features, and the main facts are worth repeating.

The owner of a house in Cathall Road, Leytonstone, brought an action to restrain the Urban District Council of Leyton from carrying on electric supply works within the district so as to cause a noise or vibration to the plaintiff. The defendants admitted that down to a certain period—July last—the works were so carried on that a nuisance was created, but stated that the alterations they had effected had remedied the trouble. It should be pointed out that the motive power at Leyton is derived from gas engines, and it is clear that under some conditions vibrations of a vertical character were bound to arise; back firing was apparently not uncommon, and this in itself being a mild form of explosion was bound to cause annoyance to neighbouring householders. On the other hand, Mr. Dugald Clark had made careful examination and tests, and had failed to detect either horizontal or vertical vibrations. The judge, however, viewed this as merely showing the possibility of running the engines without creating noise, but that it required considerable care. In spite of the testimony of the defendants' engineers, a perpetual injunction has been granted, though the operation of this does not become effective until April 9th, which allows a little breathing time to the Urban Council. Undoubtedly the matter is a serious one for the owners of the works, but it is not altogether a hopeless one, for some steam plant is actually running and other is on order. From a general view of the case two things are seen which are of great interest to the whole of the electrical industry: the liability of works to be shut down under an injunction, and the comparative failure of gas plant for driving electrical machinery. Obviously the question of being injuncted is the most serious, and tends to show how difficult it may be for electricity supply to be carried on without danger of litigation. It is easy to say that works ought to be carried outside the area of supply, but that would mean in London that the generating machinery would have to be placed outside the metropolitan area, and then there would be no knowing when other buildings would be erected close by; moreover, difficulties might be raised as to the carrying of mains through districts in which the company had no right to supply. The County of London Company's Bill was rejected on these very grounds by the House of Commons; they did not seek powers to supply electricity in a certain district, they merely sought to carry their mains through in order to get to their statutory area, yet they failed, and the point may well be raised as to whether similar treatment would not be meted out to other aspirants. It is probable that works employing steam plant are free from some of the troubles arising at Leyton, but then they have many defects of their own; they are sometimes alleged to be inveterate smokers, and our old friend vibration crops up again.

The fact that Leyton is not extending gas engines calls for some remark, because this policy was decided upon before the action alluded to was brought. Theoretically, the internal combustion engines appear to be very well adapted for central station work, and certainly it was thought at one time that they would materially aid in the economical distribution of electricity, by employment in sub-stations. Gas is so easily conveyed over large distances, needing no running machinery behind it, that it appeared to be an admirable agency to drive electrical plant, but it has signally failed to come up to expectations. Coatbridge, Belfast, and now Leyton, have struggled to show that gas engines were good, but one by one they have relinquished the attempt, and one naturally asks what it means? On the other hand, there are many private installations, some of considerable size, in various parts of the country, and these are answering admirably. These opposing results are difficult to reconcile, and one would like to hear the views of gas engine makers on the subject. Far from there being a decline of the use of gas engines for dynamo driving, quite the contrary is the case, and we believe we are correct in saying that gas engine builders are making more for electrical work than they ever made before. There is a well-known manufacturer who at the present moment is putting down 600-H.P. engines for driving dynamos, and in another place still larger units are being employed. It is curious, therefore, that while much progress is being made in private gas-driven plant the results should have been so singularly disappointing in public supply works. Save for their magnitude, the operations are precisely similar. It may be that private works employing gas engines are not so liable to injunctions as lighting stations, because manufactures, as a rule, are not carried on in proximity to dwelling houses, or if they are, the houses are of such a class that the tenants are not likely to object to vibration. In spite of the failures that have been recorded, we do not think the case against gas engines for supply works is quite made out. We can understand engineers not caring to experiment further with them, but nevertheless, they are bound to come up again, and we trust that when the next attempt is made sufficiently large units will be employed.

BILLS BEFORE PARLIAMENTARY COMMITTEES.

Southport Extensions and Tramways Bill.

This Bill came on Wednesday last week before a Select Committee of the House of Commons. Mr. Balfour Browne, Q.C., Mr. Freeman, Q.C., and Mr. J. Davies Williams were counsel for the Bill; and Mr. Worsley Taylor, Q.C., and Mr. Talbot opposed.

Mr. Freeman, in opening the case for the promoters, first dealt with that part of the Bill relating to the extension of the borough. A few years ago the Corporation purchased for the Southport Tramways Bill a portion of their lines within the borough, and they were now negotiating with the company, the lessees, for the conversion of those lines to electric traction. They were also constructing electric tramways of their own, authorised by an order last session, at a cost of £66,000.

Mr. Balfour Browne, dealing with that part of the Bill relating to tramways, pointed out the existing tramways, and said that by the Southport District Tramway Act, 1899, the Southport District Tramway Company were authorised to lay down and work a tramroad 3 miles 8½ chains in length, commencing in the borough at the north end of the promenade and passing along the sea front in a northerly direction to Crossens. That tramway was not yet constructed. Then there was the Southport Corporation Order of 1899, which was confirmed by the Act of last year, and the Corporation were authorised to construct, maintain, and work a system of tramway shown on the plan. Power was now sought to construct additional tramways, and he did not think there was any opposition to that. Ultimately, of course, all the tramways would fall into the hands of the local authority.

Mr. G. F. Trevis, chairman of the Tramways Committee of the Southport Town Council, explained that the Tramways Company had tramways in Southport and Birkdale. It was proposed to have a working agreement between the Council and the company in respect to their different lines. The Bill gave Southport power, if the Birkdale local authority did not work the tramways, to come in and work them, but they did not wish to invade the rights of Birkdale. After further discussion as to the position of the Southport Corporation with reference to that part of the tramways in Birkdale,

The Committee adjourned, and on the proceedings being resumed, it was stated by Mr. Balfour Browne that an agreement had been come to with the Birkdale local authority with respect to the clause in the Bill dealing with the tramways.

Stockport Corporation Tramways Bill.

On Thursday and Friday last week a House of Commons Committee considered this Bill, the object of which is to empower the Corporation of the town to extend the existing tramways. Mr. Pember, Q.C., Mr. Balfour Browne, Q.C., and Mr. H. Lloyd were for the promoters, and Mr. C. C. Hutchinson represented the Stockport Rural District Council, and the Parish Councils of Norbury, Torkington, Bramhall, and Bosden. The petitioners in their petition objected principally to the proposal that the Corporation should be empowered to supply electricity to tramways in their districts.

Mr. Pember, Q.C., in the course of his speech, said that the two lines now running in Stockport were owned by the Manchester Carriage and Tramways Company and the Stockport and Hazel Grove Tramways Company. The first line was subject to purchase that year, and notice of intention to purchase had been given by the Corporation. The total length of the new double lines proposed was five miles, and the length of single line five miles. With regard to the supply of electrical energy, the Corporation only took power to supply where other people had no power to do so.

At the opening of the proceedings on Friday, Mr. Hutchinson said that if the promoters would insert a clause that their powers of supply in the districts he represented should only be so long as they

that one should in this connection, first of all, direct one's

the plant and boilers having been removed to another site.

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were not able themselves, he would relinquish his opposition to that part of the Bill. He understood Mr. Pember to say that the local authorities could not supply electrical energy themselves, and therefore did not want Stockport to supply it. They did not oppose Stockport supplying for traction purposes at present, so long as they were not able to supply, but they wanted when they were in a position to supply that the right of Stockport to supply should cease.

Mr. Webb, Mayor of Stockport, mechanical engineer, said he was chairman of the Electricity Committee and a member of the Tramways Committee. The proposed tramways were 22 in number. One extended to Reddish. An agreement had been entered into with the local authority of that part to form a junction with the tramways there. Clause 38 of the Bill, which was the one principally objected to, gave the Corporation power to supply electric energy to tramways within and without the borough. The Stockport and Hazel Grove Tramway Company had no power to use electric traction, but the Corporation had the power. They only sought power to supply electric energy in districts where the local authorities were not supplying at the time. He thought that Clause 38 of the Bill was perfectly clear—that the Corporation should not supply electrical energy except with the consent of those who might be supplying energy in the outside districts. Counsel asked:—Would you be content to have words put into the clause to the effect that when the local authority were in the position to supply electrical energy for traction purposes your powers should cease on proper notice? and witness replied: I am not prepared to accept that because I am not a lawyer and do not know what the effect would be. The Corporation proposed to work all the tramways mentioned in the Bill themselves.

After other evidence had been given, Mr. Hutchinson contended that by the wording Clause 38 it would enable the Corporation to go to any company or person which might be supplying electrical energy under statutory powers and get their consent to the Corporation supplying within the district, and this would give the go-by to the Electric Lighting Acts. He would be fully satisfied if it was made perfectly clear that the powers of the Corporation should cease when the local authority were in a position to supply.

Mr. Pember said there was no company with statutory powers in the district now, and there could not be without the consent of the local authority, so that the contention fell to the ground.

The Committee found the Bill proved, and ordered it to be reported to the House.

Brighton Corporation Bill.

On Thursday and Friday last week a Select Committee of the House of Commons considered this Bill, which, amongst other matters, sought to empower the Corporation to raise £200,000 for the construction of electric tramways, and £400,000 for the construction of a generating station. Mr. Pember, Q.C., Mr. Worsley Taylor, Q.C., Mr. Baggaley, Q.C., and Mr. G. T. Talbot represented the Corporation of Brighton; Mr. Balfour Browne, Q.C., and Mr. Ram, Q.C., appeared for the Hove Town Council, and were also instructed by Mr. J. K. Nye, of Brighton, to oppose the Bill on behalf of Messrs. Fry & Co., aerated water manufacturers, of Brighton; Mr. Littler, Q.C., opposed on behalf of the Brighton and Hove Gas Company; Mr. Rickards, Q.C., opposed on behalf of frontagers in Dyke Road, and petitions in opposition to the Bill had also been presented by the East Sussex County Council, Shoreham Harbour Trustees, Portslade Urban District Council, and Steyning East Rural District Council.

Mr. Pember, in opening the case for the promoters, said there were three main proposals in the Bill in which the Committee would be troubled possibly with some opposition—the proposed electric tramways, the construction of an electric generating station some three miles from Brighton, and the bringing of mains into Brighton for the general use of the borough. The other matters in the Bill were practically unopposed. With regard to the tramways, they would be wholly inside the borough. The demand for tramways in Brighton was very strong indeed, so strong that out of all the lines proposed there was only opposition from frontagers to one. The Corporation sent a committee to various towns on the Continent as well as in England, and ultimately decided to adopt the overhead trolley system. All the tramways would be connected and form a network over such streets as were thought most fit for the purpose. He understood one of the grounds of opposition by frontagers in Dyke Road was the narrowness of the road, but any possible obstruction to the traffic on that account would be got over by a system of cross-overs by which the cars would be able to cross and recross from one line to another in order to give passing vehicles as much room as possible. The Corporation were seeking powers to work as well as to construct the tramways. In connection with the scheme, they also proposed to carry out street improvements in Brunswick Place and Viaduct Road. The Brighton and Hove Gas Company alleged that their mains and services would be seriously damaged by the use of electric power for working the trams, and that it would cause great inconvenience to them. If that was true of Brighton, it must be true of every town or road in the kingdom where there were gas pipes laid, and unless the Committee were going to say that gas pipes and electric wires could not lie in the same street, he did not see that there could be anything special in the case of Brighton. There would be abundant precautions to prevent anything of the kind alleged.

Mr. J. E. Stafford, Mayor of Brighton, gave evidence to the effect that there was a strong feeling amongst the inhabitants of Brighton in favour of the tramways. It was proposed to charge 1d. a mile. They were advised that they could work all their lines by their present electricity system.

Alderman Sir John Blaker said that the steepness of the hills made it very desirable there should be electric tramways in the district.

Mr. Joseph Kincaid, M.I.C.E., said that the tramway would be altogether 7 miles 6 chains in length. Most of the streets were wide, and therefore the lines in most of them would be double lines, but there were portions where the streets were narrow, and there the line would be single, with stations for cars to pass one another. Tramways on steep gradients had been at work in this country for the past four years, and careful consideration had been given to brake power on tramcars in order to secure the safety of the public using the road. There were special appliances, and by the experience of the last four years they were in a position to make the working of any gradient up to 1 in 10 safe and secure to the public. There was no gradient proposed in the Brighton system worse than 1 in 10. It would require 33 cars to carry out a five minutes' service on all the routes, and putting the gross receipts at 10d. per car per mile and working expenses at 6d., the income would come to about £20,000 a year.

When the Committee resumed its sitting on the following day, evidence was given by Mr. F. May, the borough engineer and surveyor who prepared the plans and sections of the scheme. He explained that originally he laid out a line to go down Montpelier Road as well as Dyke Road, but in consequence of a largely signed memorial that was abandoned. He had specially gone into the question of working tramways on steep gradients when he went with the Committee of the Town Council to visit the various places in connection with the tramways scheme, and he had seen an electrical tramway working on a steeper gradient than that in Dyke Road. At Halifax they found cars had been working for some time without accident on a gradient of 1 in 10 and several other towns they visited had tramways on steep gradients. They were all worked on the overhead trolley system, and the Committee were unanimously of opinion that there would be no difficulty in adopting the same system in Brighton. Various systems of electrical traction had been discussed by the Town Council, and at one time there was a feeling in favour of the conduit system, but after the tour of inspection it was considered that the overhead trolley system was the best. It was proposed to have an overhead wire for each track carried on poles with brackets at the side of the road. The poles would be fixed on the edge of the curb at intervals of about 40 feet.

A number of witnesses were then called to prove that the construction of the proposed tramway would improve the value of property in some parts of Brighton. Evidence having been given in opposition to the scheme by residents who objected to the proposed line in Dyke Road on the ground that the street was too narrow, and further, that the overhead wires would be an element of danger to the traffic, the Committee adjourned.

After further consideration of the Bill on Monday, the Committee found the preamble of the Bill proved, with the exception of the proposed tramroad along the Dyke Road. The Committee then proceeded to consider the clauses.

Huddersfield Corporation Tramways Bill.

A Select Committee of the House of Commons on Thursday last week considered this Bill. Mr. Balfour Browne, Q.C., Mr. Benn, Q.C., Dr. Williams, and Mr. Harper were for the Corporation. Mr. Pope, Q.C., Mr. Littler, Q.C., and Mr. Page, Q.C., were for the Lancashire and Yorkshire Railway, and several other opponents reserved counsel.

Mr. Balfour Browne, Q.C., for the promoters, said the Bill was one to enable the Corporation of Huddersfield to construct additional tramways. There was a population of 100,000 scattered over a very wide area and tramways were very essential. Hitherto all the tramways had been worked by steam, and for a time the tramways were in financial difficulties, and had to be subsidised from the rates to the extent of £41,238 during their career. Now, however, the tramways were paying, there being in 1898 a surplus of over £800. It was proposed to convert the tramways from steam to electric traction on the overhead trolley system, and to extend both inside and outside the borough. With regard to the outside extentions, the capital would be found by the Huddersfield Corporation, and they would work them, but the local authorities concerned would have the power at the end of 21 years to purchase them if they liked. The tramways would cost £260,000, and the equipment, &c., would bring up the total asked for in the Bill to £399 000. The only petition he need deal with was the Lancashire and Yorkshire Railway, who served several of the districts where the tramways were proposed to be taken, and they urged that their interests would be prejudicially affected. They were fully prepared to construct the tramway line to meet the views of the railway, so that none of their property would be injured. Up to the present the Corporation had had power to carry goods, but they would be precluded by that Bill from carrying goods because the gauge would be reduced to 4 feet 7½ inches.

Mr. K. F. Campbell, engineer to the Corporation, who prepared the plans and estimates for converting the existing tramways to electric traction, said that under a provisional order recently the Corporation had been authorised to equip 11 miles of electric tramways. The Corporation had been approached by the outside districts to provide the tramways. It was necessary that the tramways should be electrically equipped, and judging from results in other details, he thought they would be a success. The estimated cost of construction and electrical equipment was £399,350. The streets in which they proposed to double the lines were quite wide enough to comply with the Board of Trade regulations. Replying to Mr. Page, Q.C., witness said that he personally thought that a fare of 3d. to 4d. from Huddersfield to Brighouse would make it a paying concern. The cost of laying the line would be £5,000 a mile, and the cost of equipment £5,000 a mile. The districts of Meltham and Stanland had asked to be included, but they were too late to be put in the Bill. In answer to Mr. Morton, M.P., witness said there had been no objection by any esthetic inhabitant to the proposed overhead trolley system, and, in fact, there was only one objection at the town meeting. They had

reconcile, and one would like to hear the views of gas engine makers on the subject. Far from there being a decline of

that if the promoters would insert a clause that their powers of supply in the districts he represented should only be so long as they

practically given up all hopes of the underground system of electric traction.

Evidence in favour of the Bill having been given by Mr. J. H. Hanson, A.M.I.C.E, the Committee adjourned.

The following day Mr. J. P. Pogson, manager of the tramway system of Huddersfield, stated that the cost of working the tramways at present by steam was 10d. per mile, whilst the cost of running by electricity, as shown by the experience of other towns, was from 4½d. to 5d. per mile. Other evidence was called to show that the opposition to the scheme within the borough was practically *nil*, while a number of witnesses from the outside districts where it was proposed to make extensions were put into the chair to show the great advantages of the scheme.

Mr. Littler, Q.C., on behalf of the Lancashire and Yorkshire Railway, contended that the action of large municipalities going outside their boundaries and making connections with the tramway systems of other large towns was never contemplated by the Legislature. The result might be a great system of tramways which would develop into a trade system.

Evidence having been called in support of Mr. Littler's contention, the Committee announced that they would give their decision on Monday.

On Monday, the Chairman said that the Government having given notice of a motion to appoint a Joint Committee of both Houses of Parliament to inquire into municipal trading, the Committee could not grant such a large and extensive system of tramways as was sought outside the borough area, but they were willing to grant the alterations and additions asked for inside the borough, as well as to allow the proposed adoption of electricity.

The clauses of the Bill were then adjusted, and the Bill was reported to the House.

London County Council Tramways.

On Monday the Select Committee, presided over by Mr. S. Hoare, commenced the consideration of the Tramways Bill of the London County Council. Mr. S. Pope, Q.C., Mr. Freeman, Q.C., and Mr. Du Cane appeared for the London County Council. There were a large number of petitioners against the Bill, amongst whom the Wandsworth Board of Works were represented by Mr. Pembroke Stephens, Q.C., and Mr. Vesey Knox, the St. Saviour's Board of Works by Mr. F. Dodd, the South Metropolitan Gas Company by Mr. Castle, Q.C., the Vestry of Battersea by Mr. Vesey Knox, the Lambeth Water Company by Mr. Claude Baggallay, Q.C., the East London Railway Company by Mr. Reader Harris, Q.C., and the Vestry of Hackney by Mr. Erskine Pollock, Q.C.

Mr. Pope, in opening the case, said the object of the Bill was to empower the London County Council to use electricity as a means of traction. When the tramway systems were first introduced, powers were taken to purchase them within a certain number of years. The Council had already purchased some, and others were about to be purchased, whilst various links in the chain of tramways were projected in another Bill which they were promoting. Since the tramways were first laid, various systems of mechanical and electrical traction had been invented, and power had been given to municipal authorities to work as well as construct tramways. The only question was by what method of traction the London tramways should be worked. The Bill gave the County Council power to employ the best system they could find, and they intended to adopt at least in the more crowded parts of the city—the conduit system, which caused the least possible electrical disturbance. All the trouble complained of by the local authorities could be avoided by the use of the conduit system, and they had in the Bill agreed not to adopt the overhead system in any district without the consent of the Vestry. It was desirable, however, to retain the power to use the system, since in the East, South, and South-West London, there were districts where its adoption would be both convenient and economical. They had had a good deal of discussion with the local authorities interested in the question; and out of the 40 authorities in the County of London, only three appeared to oppose.

Mr. J. Williams Benn, chairman of the Highways Committee of the London County Council, gave particulars as to the tramway lines in the County of London. He said that at present there were 115 miles of tramways in London, of which the Council had purchased 72 miles. By the end of 1903 additional lines 30 miles long would fall into the Council's hands. The tramways north of the Thames had been purchased by the Council for £817,000, and those south of the Thames for £887,000. The North Metropolitan Tramways Company paid to the Council last year £78,000, £45,000 of which represented fixed rent and the remainder a proportion of the profits. At the present time the Council was making a profit on the northern system of £38,000, and on the southern of £44,000, or a total of £82,000, which all went in reduction of rates. When electrical traction was introduced they hoped to still further increase those profits. In Glasgow the receipts of horse cars were 11·51d. per car mile, and the expenses 8·51d. per mile—a profit of 3d. per mile. In electric traction the receipts had been 13·89d. per mile, and the expenses 6·38d. per mile, or a profit of 7·51d. Their results were hardly as successful as those in Glasgow, but they expected an additional profit of 3·38d. per car mile, or for the 10 million mileage, of £140,000. To make the required electric installation would require an outlay of £850,000, and allowing £59,000 for interest and sinking fund at 7 per cent. per annum, a saving of £81,000 still remained. The lease of the northern portion of the tramways would fall in to the Council in 1910. By the use of electricity there would be a saving in space, and higher speed, and 17,000 horses would be dispensed with.

Prof. A. B. W. Kennedy, F.R.S., said that last year he had been asked by the County Council to report on the possibilities of electric traction in London. He examined the systems in use in Europe and the United States, and reported that it was quite possible to carry out electrical traction in the crowded streets of London without the use of overhead wires or poles, and that an underground system could be used which would be effective and cheap. In many places where the roads were not crowded an overhead system could be advantageously employed. He had concluded that there would be no difficulty in working tramways electrically in London and had prepared plans. The slot would be like that in the cable line at Brixton, which he considered had never caused any inconvenience. The conduit system had been tried in a number of large cities and with the greatest success. They were about to make experimental trials on the line from Tooting to Westminster, half of which would be fitted on the conduit system and half on the surface contact system. By one or the other systems they could devise a scheme to work the tramways efficiently and economically.

In cross-examination by Mr. Castle, Q.C., Witness said he did not think there was any real danger of the electric currents interfering with the gas mains.

On the Committee resuming on Tuesday, the cross-examination of Prof. Kennedy was continued. He said he was opposed to the adoption of the overhead system in crowded thoroughfares, though the Council took powers by the Bill to use that system if thought fit. The best system was the conduit system with the insulated return. The maximum depth at which the line would be laid was 2 feet 3 inches, but in some places the disturbance would be as small as 1 foot 3 inches. Though the Vestry of Wandsworth had an absolute veto, they had allowed the trial of three separate mechanical systems in their district—the cable on the Brixton part, the conduit and surface contact systems on the experimental line to Tooting.

Sir Alex. Binnie, the chief engineer of the London County Council, said he thought it would be a great public advantage if all the tramway systems were in one hand and on one uniform system. At the present time an enormous number of people were carried in the Council's trams. He entirely supported the evidence of Prof. Kennedy.

The Chairman asked as to the life of the tram lines and equipment.

Witness said the life would be about 30 years, but in practice the progress of electricity was so rapid that the equipment would most likely become antiquated before that time.

This concluded the case for the promoters.

Mr. Reader Harris, Q.C., addressed the Committee on behalf of the East London Railway Company, and urged that they should have a protective clause to relieve them from any responsibility should they require to alter their bridge or station at Deptford.

Mr. Castle, Q.C., on behalf of the South Metropolitan Gas Company, and Mr. Claude Baggallay, Q.C., on behalf of the Lambeth Water Company, also asked for protective clauses, and for compensation for any damage done to their mains and pipes.

Mr. Erskine Pollock, Q.C., having addressed the Committee on behalf of the Hackney Vestry, the Committee adjourned.

LEGAL.

Smeeton and Another *v.* Williams.

Mr. Justice Kennedy, sitting without a jury in the Queen's Bench Commercial Court on Friday heard this case. It was a claim by the firm of Smeeton & Page, electrical engineers, for balance of payment for work done under a contract with the defendant. Mr. Rufus Isaacs, Q.C., and Mr. Fleming appeared for the plaintiffs, and Mr. S. Evans, M.P., for defendant.

The case arose out of the building of some large flats in Harley Street by Mr. Howell Williams under a building contract. Messrs. Smeeton & Page were entrusted by the defendant with a contract to do certain electrical work. Under the contract the architect had power to certify in the usual form, making him sole judge of what was necessary and right to order. He ordered certain things, and certified altogether for an amount of £379 14s. The defendant had paid £275, and the architect's final certificate was delivered on January 5th for £104 14s. Deducting discount, the balance was brought to £94, which was now claimed. The defendant's answer to this was that the contract only included work for electric wiring and electric bells, and that part of the amount which was included in the architect's certificate for £379 was work relating to fittings, and therefore not within the authority of the architect to certify, and not within the contract. The defendant also said he had discovered that in paying the £275 he had paid £15 too much, and he counterclaimed for that amount.

His Lordship disallowed one item in respect of fittings which he held did not come within the contract, and gave judgment for the plaintiffs on the claim for £40 19s. 6d., and also for the plaintiffs on the counterclaim, with costs.

Attorney-General *v.* National Telephone Company.

Before a Divisional Court of Queen's Bench, composed of Mr Justice Grantham and Mr. Justice Phillimore on Friday last, the case of the Attorney-General *v.* National Telephone Company, Limited, came up. This was an *ex parte* motion for an interim injunction to restrain the defendant company from breaking up the streets without license.

The Attorney-General (Sir Richard Webster, Q.C., M.P.), appearing in support of the motion, said it raised an important

district.

Mr. JOSEPH KINCAID, M.I.C.E., said that the tramway would be fact, there was only one objection at the town meeting. They had

question of law, whether the defendant company could go on breaking up the streets without the license of the Postmaster-General, and incidentally that of the London County Council. It was, he understood, the contention of the National Telephone Company that they had independent rights which entitled them to do what they had been doing. Of course, the Postmaster-General could not consent to the streets being broken up indefinitely unless some decision was given on the point. It would be impossible to dispose of the matter in a short time, and for that reason he asked their Lordships to arrange to take the motion on Thursday, April 5th, when it could be fully argued and treated as the trial, and therefore if it had to go to the Court of Appeal, it could go at once.

Mr. Justice GRANTHAM observed that his learned brother could not arrange for that particular day, but so far as he knew, he should himself be able to sit then, and he would make it convenient for that day, as it was his duty to help the parties. And accordingly he would arrange for a Court on that day.

The ATTORNEY-GENERAL desired to make this other observation. In the regular course he should have asked for an undertaking from the other side. He understood that Sir Edward Clarke could not give that, but as the defendant company did not contemplate doing any fresh work during the interval, he would not press the matter.

Sir EDWARD CLARKE, Q.C., for the National Telephone Company, said it was of very great importance to them that a decision should be arrived at as early as possible, and he was content that the motion should stand over, giving no undertaking.

Accordingly, the hearing of the motion was fixed for Thursday, April 5th.

TURNER *v.* BRINSMEAD.

IN the Queen's Bench Division of the High Court of Justice on March 19th the case of Turner & Son *v.* Brinsmead (which has been previously reported in our columns) was again mentioned before Mr. Justice Mathew, sitting for the hearing of commercial causes. This was an action by the plaintiffs, Messrs J. Turner & Son, of Manchester, to recover from the defendant, a builder in London, for the supply of an electrical lift, which defendant declared not to have been supplied in accordance with contract, was unworkable, and had to be replaced by a lift from another manufacturer. There was also a counterclaim by the defendant. At a previous stage in the hearing of the case his Lordship suggested the advisability of his having the assistance of an electrical expert as assessor, and Prof. Kennedy was selected for that purpose. The case was last before his Lordship on February 6th, when it was suggested that there should be an endeavour between the parties to come to terms.

On Monday last Mr. J. ELDON BANKES intimated that during the interval the parties had tried to come to a settlement, but they were as far off as ever, and there was no chance of any agreement, and he (counsel) had, therefore, to ask that the case should come into the list again. Mr. Bankes further asked that plaintiffs should see the report of Prof. Kennedy, so as to inform themselves whether or not further evidence would be necessary.

His LORDSHIP observed that if the case were to come on again it would be necessary that the Court should know whether it would be necessary to have Prof. Kennedy there again. He (the judge) had fixed the remuneration of Prof. Kennedy at £75 guineas, to be paid equally by the parties. When that remuneration had been paid, copies of the report could be obtained.

Mr. BANKES said that when they had seen the report they would ask for the fixture of a date for re-hearing.

GOLDBERG *v.* THE CORPORATION OF LIVERPOOL.

BEFORE Vice-Chancellor Hall, at St. George's Hall, Liverpool, on 19th inst., this case was again mentioned. A fortnight ago, after a lengthened hearing, the Vice-Chancellor decided an action brought by the plaintiffs against the Corporation, by ordering the removal of an electric tramway pole and fuse box which had been placed close to the door of the plaintiffs' business premises in Paradise Street, thereby, as alleged, causing an obstruction. Mr. Maberly, on behalf of the Corporation, said that notice of appeal had been given, and his application now was that the order for the removal of the pole and box be suspended until the appeal was heard. Mr. Rotch, for the plaintiffs, said the balance of convenience was against Messrs. Goldberg. The appeal might not be heard for a considerable time, and if the Corporation were successful in their appeal the plaintiffs would have to pay the cost of the removal. He submitted that the order for removal ought to be executed at once.

The VICE-CHANCELLOR said he had given his judgment, and he was not in a position to say how the matter of convenience stood, or what effect it would have on the electric wires if the pole were removed. He thought the best way would be that Mr. Maberly should make an original motion next week to have the mandatory injunction suspended until after the hearing of the appeal. Mr. Rotch would have an opportunity of being heard on that, and then he (his Honour) would continue the suspension until that motion was disposed of.

Counsel agreed to adopt the course suggested by his Honour.

Acid-Resisting Composition.—Messrs. J. R. Peace and Co., 11, Old Hall Street, Liverpool, are placing on the market an acid resisting paint in various colours. They claim for it that it is a good insulator, and that it is unaffected by acid moisture, oil, sea water, or steam. Samples and particulars will be forwarded on application.

CORRESPONDENCE.

Wiremen's Woes.

Will you kindly let me call attention to a grievance which I fear is daily becoming more common; I refer to the habit of many firms putting labourers on as wiremen after they have been a few months in the trade. I consider it very unjust to the many who, like myself, have served from three to four years at the trade at an average weekly wage of from 6s. to 8s., to find when we are out of our time that a man with no knowledge of the trade can, after three or four months, receive from 25s. to 27s. per week. I could give many examples, but one in particular I should like to call your attention to.

About eight months ago a labourer started for the firm in whose employ I am at present. He was a Swede by birth, and exceptionally dense, yet this man was put in full charge of the lighting of a large meat boat having over 150 16-c.p. lamps. During the whole time the work was in progress this man had to refer to one of the men under him as to how everything was to be done. When the boat was finished and everything satisfactory, he took all the credit to himself, and will in future be looked upon as a man to be trusted with full charge of similar work until (and I hope that will not be long) he does not find a man under him who can do the work.

This is a state of things which should never be tolerated, and I think it only needs to be made generally known to be abolished altogether.

H. W. H.

P.S.—This letter was prompted by your article *re* "The Electric Wiring of Buildings" in the ELECTRICAL REVIEW for March 16th.

Municipal Retrogression.

I feel that an apology is necessary for asking for space in a technical journal to reply to the letter of Mr. Thomas Winstanley in your current issue, but, glaring though the mis-statements and inaccuracies may be to your technical readers, they might mislead non-technical persons into whose hands the letter might fall, and I trust, therefore, that this possibility will be sufficient to justify me for trespassing on your space.

In the first place, lighting is not charged for in Manchester at a uniform price of 5d. per unit, but on a sliding scale whereby the price falls from a maximum of 5d. as low as 1·44d. per unit for lighting, while the cost for power when used for moderate hours is 2½d. per unit, and for long hours 1½d. per unit. The average price obtained last year from consumers of all classes, when the charges were slightly higher, was 3·33d. per unit.

The average costs of production for the whole supply last year were 1·54d. for revenue charges, and 1·06d. for capital charges, or a total of 2·6d. per unit sold.

It is, however, a truism that the average cost of production is no guide to the cost of supplying individual consumers, this latter depending entirely upon the length of time over which their demand extends. The Hopkinson system of charging in use in Manchester is so calculated that the percentage profit made from every class of consumer is approximately the same; in other words, the very opposite of what your correspondent states is the fact—that is to say, we do not make the profitable consumers pay for the unprofitable, but use a scale which charges a consumer approximately in proportion to the cost of supplying him.

The object of charging 1½d. to power users is not to obtain a day load, as I have on many occasions pointed out in public, but to obtain a long-hour load, and this long-hour load is cultivated equally for lighting as for power, many of our consumers obtaining current for lighting purposes at from 2d. to 2½d. per unit, and a few even as low as 1·44d. per unit.

I do not know whether Mr. Winstanley has any inducement to discontinue the use of gas for lighting. I can only say that an enormous number of ratepayers have found the inducement very strong, and the increase in connections is taking place at an increasing rate.

Whether we are behind America and the Continent in electrical matters or not I do not wish to argue Personally

I think we are b fore both in most things, but I confess that it is news to me that the average charge in America is ½d. per unit. In my ignorance I had always supposed that the average charges were higher on account of the higher cost of coal. It is true that in a few isolated cases of water-power supply used continuously on electrolytic work the charges are exceedingly low, but a few large water-power schemes which, by reason of their exceptional interest, are described in English journals, must not be taken as representative of ordinary American practice. The bulk of the American stations are driven by steam plant, and have to work on ordinary lighting loads in a precisely similar manner to English stations.

Mr. Winstanley states that under the present system in Manchester something cannot be altered, but what, does not very clearly appear. He is perhaps unaware that a station as large as those contemplated in the Bills he refers to is about to be constructed by the Manchester Corporation, and that it will supply a district of some 45 square miles, embracing every possible variety of load.

As regards the rural districts, if any consumers are to be found in them, it is to be hoped that the large companies will of their charity supply them. I fear, however, that if there are many, the drain on the companies' resources will be somewhat heavy.

I can well believe that the companies do not want to pull up the streets, but unfortunately for them there is a Board of Trade which will require them to do so; overhead lines conveying current at very high pressures being somewhat dangerous in thickly-populated districts.

In conclusion, I can only reiterate the first portion of Mr. Winstanley's concluding remark, "the public in general do not know very much about these schemes," and add that Mr. Winstanley appears to be an excellent representative of the public.

C. H. Wordingham.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Mar. 21st, 1899.		Week ending Mar. 20th, 1900.	
Alexandria	Value £150	Adelaide	Value £550
„ Teleg. stores	23	„ Teleg. mat.	456
Amsterdam	200	Amsterdam	355
Barcelona	31	Auckland	114
Berbice	13	Beira	64
Boca. Teleg. mat.	106	Bombay	69
Bombay	136	Brussels	30
„ Teleg. mat.	180	Buenos Ayres	400
Boulogne	159	„ Teleg. mat. ..	280
Brisbane	18	Calcutta	1,094
„ Teleg. mat.	209	Canterbury	14
Buenos Ayres	3,358	Cape Town. Teleg. mat. ..	118
„ Teleg. mat. ..	539	„	20
„ Teleph. mat. ..	76	Colombo	72
Calcutta	258	Copenhagen	358
Cape Town	328	Delagoa Bay	2,621
Christiania	68	Durban	117
Colombo	65	„ Teleg. mat.	747
Delagoa Bay	95	East London	155
Durban	343	Fremantle	104
„ Teleg. mat.	103	Gibraltar	27
Ghent	25	Gothenburg	40
Gothenburg	72	Halifax. Teleg. cable ..	120,000
Hamburg	200	Hamburg	30
La Plata	20	„ Teleg. mat.	300
„ Teleg. mat. ..	88	Kobe. Teleg. cable	941
Limon. Teleg. mat.	86	Melbourne	412
Melbourne	47	„ Teleg. cable ..	201
Odessa. Teleg. mat.	20	Monte Video. Teleph. mat. ..	148
Ostend	85	Reval. Teleg. mat.	400
Port Elizabeth	391	Rotterdam	427
Rangoon. Teleph. mat.	16	„ Teleg. mat. ..	600
Santa Cruz	35	Singapore	114
Shanghai	229	„ Teleg. mat.	407
Singapore	99	Sydney	1,778
„ Teleph. mat.	21	Wellington	198
Sydney	554	„ Teleph. mat. ..	318
Tientsin. Teleg. mat.	104	Yokohama	443
Wellington	179	„ Teleph. cable ..	206
Teleg. mat. ..	190		
Total ..	£8,914	Total ..	£134,627

Foreign Goods Transhipped.

Gothenburg. Teleph. apprats. Value £2 | Brisbane. Teleph. apprats. Value £178

Bankruptcy Proceedings.—Mr. Registrar Hope, sitting on Thursday last week at the London Bankruptcy Court, gave judgment upon the application for an order of discharge made on behalf of Edward Lionel Joseph, electrical engineer, Northampton Works, Northampton Grove, Canonbury. According to the Official Receiver's report, the bankrupt failed last May with liabilities £7,616 9s. 1d., and assets of doubtful realisable value. Proofs for £2,079 were lodged by creditors, and the estate has only produced £4. The bankrupt in March, 1891, was taken into partnership by his former employers, and became manager of the business at a salary and commission of about £250 a year. In course of time two of the other partners retired, and from 1894 to 1896 the business was carried on by the bankrupt and Mr. Williamson, under the style of Williamson and Joseph. In 1896, with a view to the conversion of the business into a company, the bankrupt arranged to buy out his partner for £4,526, being one half of the capital of the firm at that time, according to the books of account. In March, 1896, the company was formed with a nominal capital of £10,000, divided into 5,000 ordinary and 5,000 preference shares, and £5,500 in debentures of £100 each. The bankrupt, as vendor, was entitled under the contract to receive £4,526 cash (the amount he had agreed to pay to his partner), payable by quarterly instalments of £100 each, and £4,993 in fully paid shares, that being practically the whole of the ordinary shares of the company. The shares were duly allotted, but only three of the instalments of £100 had been paid, and these the bankrupt passed over to his late partner in pursuance of the agreement. The bankrupt continued to act as managing director at a salary of £8 a week down to April, 1899, when a receiver was appointed at the instance of the debenture holders, who retained the services of the bankrupt at the same salary. The bankrupt attributed his failure entirely to guarantees given and liabilities incurred by him on behalf of the company. Those amounted, according to the statement of affairs, to about £860. The bankrupt admitted that his only asset was his interest in the company; that he himself had no prospect of paying the amount guaranteed in any way; and that he depended entirely upon the company, and if the company could not pay the debts he personally would be unable to do so. The company was, however, in a very good position at the time, and there was no prospect of anything happening; further, that if he had thought there was any such prospect he would not have become liable for the amount. Under the circumstances it appeared clear to the Official Receiver that while the bankrupt thought he would never be called upon to pay the liabilities, he had no reasonable or probable ground of expectation of being able to discharge them in the event of his being called upon so to do. The contracting of the debts under those circumstances, and the insufficiency of assets to pay 10s. in the £ to the creditors, were the offences charged by the Official Receiver.—Mr. Carrington, on behalf of a creditor, further charged the bankrupt with having brought an action unjustifiably against his client, and with having unnecessarily and wrongly defended the making of the receiving order.—Mr. Muir Mackenzie appeared for the bankrupt in support of the application, and challenged all the offences that had been charged against his client.—The learned Registrar, in reviewing the case, upheld the offences reported by the Official Receiver. He said it had been suggested that the transfer of the business to the company was made in order to put all the bankrupt's assets out of the reach of his creditors, but he failed to find any proof of that having been the intention. It had also been contended that the bankrupt was not responsible for the deficiency of assets, but he could not accept that view, because the debtor parted with all his assets to the company, in exchange for which he was only personally to have ordinary shares, which were now of no value. He only regarded the unjustifiably bringing of the action against a creditor as a technical offence which need not be noticed, but he thought some consideration ought to be given to his having defended the making of the receiving order. The chief point for attention was the fact that there were liabilities £7,616 and assets of only £4. Having regard to all the circumstances, the discharge would be suspended for three years. Order entered accordingly.

Notice appears in the *London Gazette* of the release of trustee, R. T. Tatham, in *re* H. W. Thane, electrical and general engineer, Rochester.

At the London Bankruptcy Court on Thursday last week, an application was made to Mr. Registrar Hope by Mr. J. C. Howell, of Llanelly, for an order of discharge. The liabilities were estimated at £10,348, and the assets consisted of an estimated surplus of £11,393 from securities and shares held by creditors, which the trustee stated were of problematical value. The Official Receiver opposed the application on the grounds (1) that the assets were not sufficient to pay 10s. in the £, and (2) that he had traded after knowledge of insolvency. The debtor was examined, and said that when he took over the liabilities from J. C. Howell, Limited, he thought he would have been able to pay them off in five years. He agreed that his assets at the present time were dependent upon his own exertions. Mr. Registrar Hope upheld the offences alleged, and said the debtor seemed to have been the guiding or moving spirit of the different companies with which he had been connected. As the assets were dependent upon his personal exertions, he thought that the discharge should be suspended until 10s. in the £ was paid, liberty being given to the debtor to apply to modify the order after the expiration of two years.

A meeting of creditors was held at Leeds, last week, regarding the affairs of Frederick Metcalfe, electrical engineer. The liabilities are £125 16s. 10d., and the assets £6 7s. 10d. The debtor attributes his failure to loss on contracts.

Books Received. — "Sell's Directory of Registered Telegraphic Addresses." London: H. Sell. 21s.

"Electric Wiring." By C. P. Poole. New York: The Power Publishing Company.

No. 38, "Fire Tests with Floors," No. 40, "Fire Tests with Doors." London: The British Fire Prevention Committee. 2s. 6d. each.

Catalogues, Lists, &c. — The British Westinghouse Electric and Manufacturing Company, Limited, has issued circular No. 1,019, March, 1900, in which alternating current switchboards of type 6, for polyphase circuits 1,100 to 2,200 volts, are described in considerable detail with diagrams, schedules of apparatus; a large variety of types of generator and feeder panels are particularised.

Messrs. Allan & Adamson, Limited, send us an illustrated price

steam. Samples and particulars will be forwarded on application.

Whether we are behind America and the Continent in electrical matters or not I do not wish to argue Personally

list of the "Allan" accumulators in which the D, DD, E, FO, and HV types for lighting, motor car, traction and a variety of other purposes are detailed.

Mr. J. W. Nasmith, of Manchester, has issued a circular relating to his specialities for steam users, including steam traps, valves, damper and pump regulators.

From the Electrical Sundries Company, of 10, Berner's Street, W., there comes to hand a new and well bound catalogue in which, as the name of the company implies, there are numerous fittings and other things required in electric lighting and other work. Various designs of standard lamps, electroliers, pendants, hall lanterns, switches and so on are shown, elaborate and otherwise. A good paper, clean printing, and the absence of cramping have resulted in the production of a neat list.

A comprehensive and well printed catalogue and price list comes to hand from the Bergmann-Elektromotoren-und Dynamo-Werke Aktiengesellschaft, in which particulars are given (in English) of motors of all kinds for domestic purposes, direct and alternating, and generators for outputs from 0·18 to 250 KW. A large variety of motors for industrial purposes is also listed, a special section being set apart for motors adapted for driving printing presses.

Messrs. Walker & Hodgetts, George Street, Salford, send lists of dynamos and motors. These are fitted with improved bar armature and have self-oiling and aligning swivel bearings. The machines seem to be well designed and are made in suitable standard sizes.

Messrs. Rowland Carr & Co., contractors for electrical, railway and other stores, of Lime Street Square, E.C. have issued a neat hanging show card of their electric light and traction castings for posts, pillars, underground pipes, &c.

The B.T.H. Company's pamphlet No. 56 describes slow and moderate speed motors (type C.E.) and contains illustrations showing their application to driving printing and other machinery.

Messrs. Vaughan & Son, Limited, of Manchester, have issued a reprint of a well illustrated article on "The Development and Construction of Electric and other Travelling Cranes" which recently appeared in an engineering journal. There are some excellent views of cranes supplied by Messrs. Vaughan.

The Copper Market.—Messrs. H. R. Merton & Company's statistical circular for the first half of the current month, shows that stocks have gained 533 tons, while the price of G.M.B.'s has advanced £2 5s. per ton—from £74 15s. on February 28th to £77 on March 15th. This latter is the highest price since April 30th, 1899, when G.M.B.'s were quoted at the same figure. The total supplies during the 15 days ending March 15th have been 12,336 tons, and the total deliveries 11,678 tons. In addition to the latter totals, 125 tons have been shipped to New York. The stocks of copper, which on February 28th were 22,982 tons, have therefore advanced to 23,515 tons.

Electricity in Shirt-making.—Messrs. E. D. McCrae's new shirt and collar factory in Wood Street, Dublin, is supplied throughout with electric light, and all the machinery is worked by electric motors, including the guillotine knives which could at one stroke cut six dozen collars. The electricity is generated on the premises with a Crossley gas engine and dynamo. They have a plant for making their own gas.

For Sale.—From our small advertisments this week may be obtained particulars of electric lighting plant for sale at the Whitechapel Free Library. It includes a gas engine, dynamo, battery, &c.

German India-Rubber.—The *Birmingham Post* says: "That little gold mine, the Continental India-Rubber and Gutta-Percha Company, of Hanover, has just announced that it can this year pay a dividend of 40 per cent. per annum, a decrease of 15 per cent. compared with the previous year, when the shareholders received 55 per cent. The gross profits this year amount to £108,000, of which £13,200 are used for writing-off purposes, £25,000 for depreciation of stock on hand, £3,750 for the workmen's funds. The stock on hand is valued at about £125,000. The company's cycle manufacturing branch has so far swallowed up over £100,000 in positive losses. The annual report ascribes the smaller percentage of the dividend mainly to the high price of crude rubber and other necessary raw material, the rise in wages, in the price of fuel, &c., for which the rise in the finished products was no adequate set-off, although the Rubber-ball Syndicate did good work. Prospects for the early part of the current year were eminently satisfactory."

In re The River Plate Electric Light and Traction Company, Limited— Guinness v. the Company.—This matter came before Mr. Justice Cozens-Hardy in the Chancery Division on Saturday last on a motion for judgment in a debenture holder's action. Mr. Vernon, in support of the motion, said that there had been default in the payment of interest on the debentures, and although there had not been six months default the company appeared and consented to judgment. Counsel for the company saying that he could not oppose an order being made, judgment was accordingly entered in the ordinary form in a debenture holder's action.

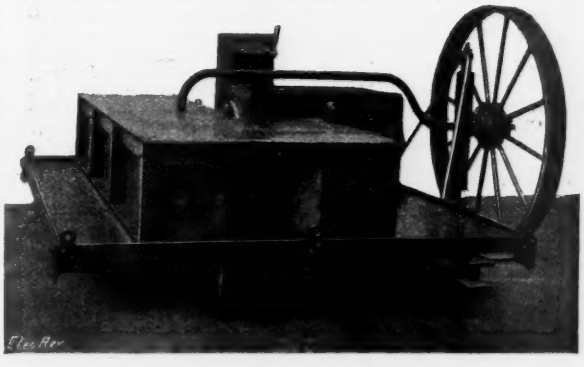
Isolit Telephone Bells.—The sound of metal telephone bells being frequently considered disagreeable, particularly if there be several in the same room, has been the cause of some telephone manufacturers substituting wooden bells. As, however, these are liable to split, through variation of temperature and other reasons, Messrs. Adt, of Ensheim, have introduced a bell made of "Isolit," which cannot split, and which is not affected by the weather. These bells are said to have qualities which do not exist in metal or wooden bells. They give a muffled sound, but are amply loud enough to be distinctly heard at a considerable distance. They are admirably suited for sick rooms, or to nervous people, who have to deny themselves the luxury of electric bells or private telephones on account of the sudden and somewhat harsh noise of metal domes. These "Isolit" bells are made in brown colour, varnished and polished, in sizes from 60 to 150 mm. diameter. Mr. Archibald Campbell, of 28, Gray's Inn Road, W.C., is the London agent for these bells.

The Jones Mechanical Stoker.—This stoker finds a place in the columns of *Engineering*. It consists of a fire grate, if we may so term a solid plate surface, up the centre of which is a sunk hopper trough. This extends the full length of the fire, and at its outer end is fed with coal by a reciprocating plunger. This plunger carries also a rod extending right along the trough and through the extreme end of it, and on this rod are additional pusher pieces which are made with one side vertical and one side flatly sloped, whereby they can retreat easily through the coal in the hopper and yet push it onward during their other stroke. The coal thus fed in overflows and is represented as rising up all along the trough and forming a round backed heap of fire all along the grate. The only air admission is along the top edges of the coal trough, and we do not see that this is in any way sufficient. We are not treated to any reasons for the solid grate and paltry air admission, and we do not believe the air slots will admit air enough for proper combustion. We might also remark that it is extremely doubtful if any coal will be found of which the angle of repose is so flat as to spread the coal over the fire surface as shown. The central heap would need to be much higher. We must confess to a feeling of doubt as to underfiring. The green coal fails often to come up under the burning fire, but breaks through it and is apt to become a dead black mass unless very slowly fed in. As we write this on March 17th we may be forgiven for suggesting that the best underfired furnace is that in which the fuel is thrown on the top of the fire and the draught is downwards through a water grate. We should estimate the possible rate of combustion in this stoker as very moderate.

The Nernst Lamp. — The authorities of the central station at Gottingen, Germany, have just furnished some of their clients with Nernst lamps of 25 C.P.

Paterson, Cooper & Co., v. Earnshaw.—At the Glasgow Court of Sessions some days ago counsel were heard in an appeal under the Workmen's Compensation Act by the respondents in an application by Henry Earnshaw, joiner, residing at Stockton-on-Tees, for compensation for injuries from his employers, Paterson, Cooper & Co., electrical and mechanical engineers and contractors, Abbotsinch, Paisley. The claim was for £1 a week. Earnshaw was on April 1st, 1899, working for Paterson, Cooper & Co., in the fitting up of electric light apparatus on board an unfinished ship which had been built by a firm of shipbuilders at Middlesbrough, and which had been launched and was lying in the river Tees alongside the shipbuilding yard. While at work he fell into the hold of the vessel and fractured his thigh. Sheriff-Substitute Henderson found that Paterson, Cooper & Co. were liable, and he continued the case to allow the extent of the injuries and the probable duration of the workman's incapacity for work to be ascertained. The Second Division held that the firm were not the undertakers under the Act, and that they were not the occupiers. They therefore reversed the decision, and sent the case back to the sheriff to be dismissed.

Single Rail Electric Truck.—Single rail trucks are largely used in India and in South America for transport purposes. The South American plan is to attach the balancing boom or outrigger to the ox or mule which draws the load. In India a wheel is used at the end of the outrigger, and the load is so distributed that the weight is chiefly carried by the rail wheels and but slightly

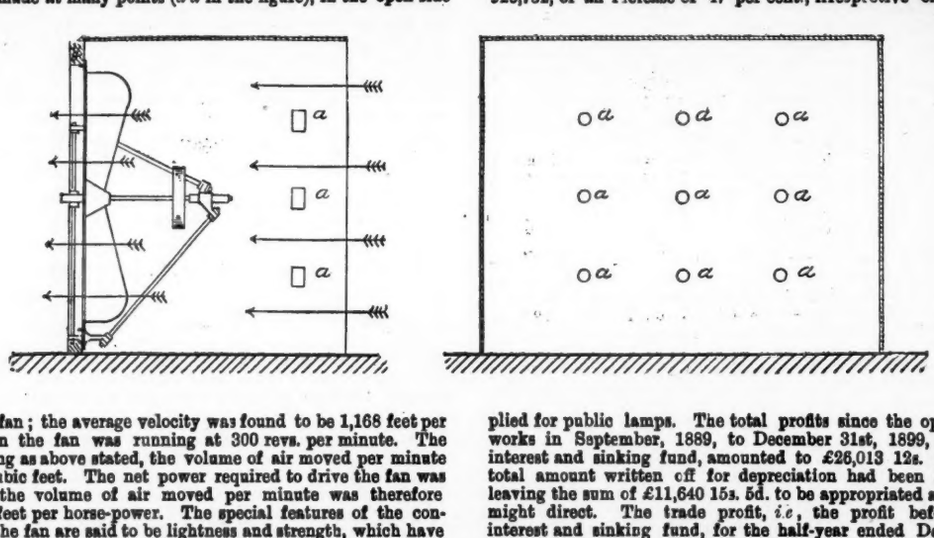


over-balanced on the side of the road wheel. Such trucks are drawn by oxen. The truck illustrated has been built by Mavor & Coulson, Limited, of Glasgow, for service in India. Each of the two wheels (which run on the same rail) is driven by independent chain gear from the motor spindle. The accumulator is carried as shown under the platform. The truck is intended to carry a load of 5 cwts., and in addition to draw two trucks, each carrying 1 ton, at a speed of 8 miles per hour.

Telegraphic Addresses.—"Sell's Directory of Registered Telegraphic Addresses" is one of those serviceable publications which, in keeping themselves up-to-date and complete, grow more

bulky year by year. The 1900 edition now before us has nearly 1,500 pp. containing the alphabetical list of telegraphic addresses which have been registered at the Post Office, from whose official lists the work is compiled. It is a truism that the use of the telegraph system is growing year by year; but it is worth remarking that no less than 87,000,000 telegrams passed through the Post Office during last year. The information includes everything received by the Post Office up to January 1st this year, and in many cases telephone numbers are also given. We have no doubt that many business men have found past editions of considerable service.

Test of a Ventilating Fan.—We give below particulars of a test recently made on the "Sun" fan, a modification of the well-known Blackman type. The fan, which was 6 feet in diameter, was belt-driven by a direct current motor, supplied at 225 volts; readings of current and voltage were made with the fan on and without, the power required to drive the fan being very approximately the difference between the two. The fan, as shown in the figure, was enclosed on the feed side by an open box, 9 feet 9 inches long by 7 feet 6 inches high, projecting 6 feet 6 inches from the fan seating; the openings in the side of the box through which the belt passed, were equal to 3·6 square feet in area, and the total feed area was 76·6 square feet. The velocity of the draught was measured by anemometer tests, made at many points (*a a* in the figure), in the open side



opposite the fan; the average velocity was found to be 1,168 feet per minute, when the fan was running at 300 revs. per minute. The feed area being as above stated, the volume of air moved per minute was 89,468 cubic feet. The net power required to drive the fan was 5·1 H P., and the volume of air moved per minute was therefore 17,543 cubic feet per horse-power. The special features of the construction of the fan are said to be lightness and strength, which have been secured by making the whole of the frame of malleable or wrought-iron. The fan is made by the Sun Fan Company, Limited, Bradford.

Thorpe and Salter v. Berry.—At the Clerkenwell County Court on the 15th inst., before his Honour, Judge Edge, Messrs. Thorpe & Salter, electricians, 17, Red Lion Street, Clerkenwell, E.C., sued Frederick Herbert Berry, electrician, 14A, Clerkenwell Green, E C., to recover £35 11s. 7d., for work done and materials supplied for the same. There was a counterclaim for £35 for the non-delivery of a lamp. Mr. Gill was counsel for the plaintiffs, and Mr. Scott for the defendant. Counsel for the plaintiffs explained that the action was to recover the balance of account for certain work done for the defendant at "Prince's Tavern," Wardour Street. Subsequent to this action there had been an application in another Court, and it was said that the work was not done for the defendant, and that he was only an agent. But the plaintiffs were employed by the defendant, and all the accounts were put in his name. He had paid sums on account, and under those circumstances he asserted that the plaintiffs were entitled to a verdict. The Judge said the real issue was whether the contract had been completed or not. The jury found a verdict for the plaintiffs for £30 9s. 7d., and the counterclaim was dismissed, with costs.

Trade Announcements.—Mr. F. W. Lanchester notifies that on January 1st his business was taken over by the Lanchester Engine Company, Limited, of Armourer Mills, Montgomery Street, Birmingham, who will attend to debts, &c.

Mr. G. W. Webb has been appointed manager of Messrs. Fry and Co., Limited, showrooms at 19, Farringdon Avenue, representing Messrs. Charles Joyner & Co., Limited, of Icknield Square, Birmingham, manufacturers of gas and electric light fittings, &c.

ELECTRIC LIGHT AND POWER NOTES.

Argentina.—The *South American Journal* says that the directors of Bright's Light and Power Company, Limited, which has the electric lighting works in the towns of Santiago del Estero and Salta, in the Argentine Republic, have just issued their report, in which they recommend a dividend of 9 per cent per annum on the paid-up capital, and a balance of £3,203 to be carried forward.

Barnard Castle.—The District Council has accepted the terms agreed to by the Northern Counties Electricity Supply Company for the ultimate purchase of the works by the Council after 31 years, with a bonus of 20 per cent. on the capital expended.

Birkdale.—Notice appears in the *London Gazette* of the transfer of the Birkdale electric lighting order (1898) from the Urban District Council to the British Electric Traction Company, who pay £700, and agree to comply with a number of conditions which are set out in the notice.

Bradford.—The accounts of the electricity department, of which we gave a brief note last week, are more fully set forth below:—The total income of the electricity department for the half-year ended December 31st, 1899, was £17,654 5s. 2d., as compared with £13,011 3s. 8d. for the corresponding period in the preceding year, or an increased income of £4,643 1s. 6d. The total expenditure for the half-year (including interest and sinking fund) was £14,256 19s. 5d., as against £10,519 10s. 3½d. for the corresponding period of the preceding year. The net profit for the half-year, therefore, was £3 397 5s. 9d., as against £2,491 13s. 4½d., being an increase of £905 12s. 4½d. on the corresponding period of 1898. The number of consumers was 1,075, as against 850, or an increase of 21 per cent. The total number of units consumed was 1,360,319, against 926,732, or an increase of 47 per cent., irrespective of current supplied for public lamps. The total profits since the opening of the works in September, 1889, to December 31st, 1899, after paying interest and sinking fund, amounted to £26,013 12s. 5d., and the total amount written off for depreciation had been £14,372 17s., leaving the sum of £11,640 15s. 5d. to be appropriated as the Council might direct. The trade profit, *i.e.*, the profit before charging interest and sinking fund, for the half-year ended December 31st, 1899, worked out to £4 19s. 2d. per cent. on a capital outlay of £202,702, and the net profit, after charging interest and sinking fund, shows a percentage of £1 13s. 5d. on the same outlay. Taking the December and the preceding June half-years together, the trade profit amounted to £17,617 19s. 1½d., representing £8 13s. 10d. per cent. on the capital outlay. The net profit for the same half-years amounted to £5,130 8s. 4½., and represented £2 10s. 8d. per cent. on the outlay. Mr. Shaw, chairman of the Electricity Committee, said that the work of extension was thoroughly in hand. As a new engineer had just been appointed, it had been thought better as to certain things to wait till he took office. The Committee had two 700-H P. engines on order. They had had the best half-year on record, despite the fact that the price for continuous power had been reduced from 2½d. to 1d. per unit.

Bridgwater.—The Town Council has appointed Mr. Trentham consulting electrical engineer, with instructions to prepare plans and specifications at once, and to carry out the electric lighting works within 14 months.

Colwyn Bay.—The District Council of Colwyn Bay and Colwyn last week received the sanction of the Local Government Board to borrow the sum of £5,120 for the purpose of the electric lighting scheme, and telegraphic instructions were instantly despatched to the contractor to commence work forthwith.

The Electric Power Schemes.—In the House of Commons, on March 15th, Lord Balcarres (Lancashire, Chorley) moved:—

That the Committee of Selection do appoint a committee, not exceeding seven members, to whom shall be committed the following private Bills by which it is proposed to supply electric power.—Lancashire Electric Power Bill, Durham (County of) Electric Power Supply Bill, South Wales Electrical Power Distribution Bill, Tyneside Electric Power Bill (read a second time on Thursday, March 1st).

Mr. Galloway (Manchester, S.W.) moved as an amendment to leave out "the Committee of Selection do appoint a committee, not exceeding seven members," and insert "a Select Committee be appointed." He said that the effect of his amendment would be that the Bills would be referred to an ordinary Select Committee, nominated by the House, upon which both the opponents and those favourable to the Bills would be represented. If, however, the motion were adopted, the Committee would be supposed to be an impartial tribunal, upon which neither side would be supposed to be represented. Sir A. Rollit seconded the amendment, and, after further remarks by other hon. members, the debate was adjourned.

On the 16th inst. Mr. Ritchie (Croydon), resuming the debate on the amendment to the motion for the appointment of a committee to

which these Bills should be referred, said, according to the *Times* report, that the hon. member for South-West Manchester proposed that the Bills should be referred to a Select Committee. There were two objections to such a committee. One was that if they were referred to what was ordinarily understood as a Select Committee the Bills would have to pass through another committee. That was a serious objection, because it meant unavoidable delay and probably the loss of the Bills this year. The other objection was that a Select Committee was nominated by the House from the two sides of the House. The House selected gentlemen who either took a great interest in the subject to be inquired into or who represented one side or other of those concerned in the Bills. That was not the kind of committee to which such Bills as these ought to be referred. What was wanted was a perfectly independent committee, quite as independent as the ordinary private Bill committee. He supported the motion of his noble friend the member for Chorley, because he desired that the Bills should be referred to a committee who should have the responsibility of a private Bill committee and yet be stronger than the ordinary private Bill committee. After other members had spoken, Lord Balcarres said that, in the event of the amendment being withdrawn, he was prepared not to move the motion standing in his name to the effect that three members of the committee should form a quorum. The amendment was then by leave withdrawn. Ultimately it was resolved that the Committee of Selection should appoint a committee of seven members, to whom the Bills should be referred.

Cardiff.—The Lighting Committee had before it on Tuesday the resignation of Mr. H. Pengelly, electric mains superintendent. The resignation was accepted and it was resolved to advertise for a successor at a salary of £150 per annum.

Crewe.—A Local Government Board inquiry was held last week into the application by the Corporation to borrow £10,000 for the work of electric lighting within the borough. The town clerk stated that the Council had already obtained sanction to spend £26,000 in electric lighting, and this additional £10,000 was wanted for lighting side streets. There was no opposition.

Dublin.—The objections of the Corporation against the Electric Lighting Bill came before the Standing Committee of the House of Lords on Monday. The objections were that the standing orders had not been complied with. After argument the Committee decided to let the Bill go before a Select Committee, who will decide the case on its merits.

Enfield.—The District Council has shelved the question of electric lighting for 12 months.

Eton.—The District Council has consented to the granting of the provisional order for the supply of electric light to the parish of Denham now being applied for by the Uxbridge and District Development Syndicate, Limited.

Glamorgan.—On the report of the special committee of the County Council appointed to deal with the South Wales Electrical Power Distribution Company's Bill in Parliament, several members spoke of the importance of encouraging the use of electricity in every conceivable manner in order to keep abreast of foreign competition. The Council declared itself in favour of the main principles underlying the Bill, and gave instructions that its opposition should be confined to clauses with a view to safeguarding the Council's interests in the matter of roads, streets, and bridges, and other points of detail not affecting the preamble of the Bill.

Glasgow.—The Corporation has made what, we fear, must be regarded as a retrograde step by resolving to discontinue the use of the demand indicator system, substituting therefor a uniform rate of 4d. per unit to 100-volt and 200-volt consumers, and 3½d. per unit to 250-volt consumers. The object of the differential rating is obvious enough, and it is probably to the real interest of all parties to secure uniformity of pressure as soon as possible; but the injustice done to long-hour consumers by the uniform rate is notorious, and sure to cause dissatisfaction.

Guildford.—The Town Council is in negotiation with the Electricity Supply Company with a view to purchasing the company's undertaking.

Hornsey.—The Hornsey District Council has passed a resolution opposing the Bill promoted by the North Metropolitan Electric Power Supply Company.

Inverness.—The Town Council last week considered the tenders for erecting electricity works, and resolved to accept the offer of the Brush Electrical Engineering Company, Limited, amounting to £21,000. The construction of the works is at once to be proceeded with. Mr. Craven is the electrical engineer.

Italy.—The central stations of the Società Anglo-Romana per l'Illuminazione di Roma, of Rome, is now supplying current to an equivalent of 84,130 16-C.P. lamps, an increase of 18,573 on the year.

London.—COUNTY COUNCIL.—The Highways Committee last week reported that a notice had been given by the City of London Electric Lighting Company, under the Southwark Electric Lighting Order, 1891, of their intention to lay mains across and along Sumner Street, along Great Guildford Street into the Southwark Street subway, and across and along Borough High Street as far as London Bridge. The St. Saviour's District Board stated that it had refused its sanction to the works, as it objected to the character and proposed position of the boxes to be constructed in connection therewith, and the Board asked that the Council would adopt a similar course. They thought that the Council should support the local authority in the matter, and recommended that the Council do formally disapprove of the works referred to. This was agreed to. The Committee also reported that they had received notice from the same company of their intention to lay mains along the subway in Southwark Street, from Great Guildford Street to the eastern end of the subway. The Council approved of the laying of these mains, subject to the usual conditions attaching to work affecting the Council's subways.

SHOREDITCH.—The attention of the Vestry was drawn at the meeting on Tuesday to the black smoke nuisance at the chimney shaft of the electric light station and refuse destructor works. It was pointed out during the discussion that the Vestry prosecuted other persons for causing a nuisance of which it was itself guilty, and that other offenders complained to the sanitary inspectors in regard to the matter. It appeared, too, that the Public Health Committee had addressed letters on the subject to the Lighting Committee, but that no reply had been received to the communications. Mr. N. Moss, chairman of the Lighting Committee, explained that the committee had been unable to obtain the quality of Welsh coal that was required, but had been obliged to get anything they could. As a consequence, the fuel procured was only of an inferior quality. The engineers were alive to the importance that no black smoke should be emitted, and they were doing everything possible to prevent it. The subject then dropped. The adjourned report of the Officers' Committee was submitted in regard to the application of the accountant for additional assistance in his department. In accordance with the report, the committee has had the headings of a set of books prepared, and on the committee's recommendation, the Vestry resolved to approve the principle of having the financial books of the lighting department kept at the station by the present staff, subject to a periodical audit by the accountant.

HAMPSTEAD.—The Vestry has decided that the electric lighting department shall contribute £12,500 towards the cost of a new stone-yard, the old one being entirely given up to that department.

The report of the Lighting Committee shows that the amount of the consumers' accounts for the Christmas quarter, 1899, was £11,471 11s. 9d., as compared with £8,514 4s. 7d. in 1898, the increase being 38 per cent. The Vestry will support the Poplar Board of Works in requesting the London County Council to promote legislation to enable metropolitan local authorities to borrow money for the purpose of wiring consumers' premises and to carry out the work.

Newmarket.—In our abstract of the annual meeting of the Newmarket Electric Light Company last week we gave the number of lamps being supplied as 2,000, with applications for another 1,000 waiting. As a matter of fact, the company has as many as 5,000 lamps connected in addition to the 1,000 mentioned. A new 100-KW. Allen machine is now being put down. Mr. Frank A. Simpson is the resident engineer at the works.

Paisley.—The Electric Lighting Authority having applied for further borrowing powers, the Under Secretary for Scotland wrote that under the statutes the Council could only borrow with his consent for the purpose of their undertaking to the extent of the unexercised margin of the borrowing powers conferred by their local Gas Acts, that is to say, the borrowing of the burgh for gas and electricity together must not exceed the total amount authorised to be borrowed under the local Gas Acts. It was reported that the unexhausted borrowing powers under the Gas Acts would, at May next, amount to £13,000, and it was decided to apply for authority to borrow for electric lighting purposes to that extent in the meantime, and make application for a provisional order authorising borrowing to the extent of £20,000 for electric lighting purposes.

River Shannon.—The Shannon Water and Electric Power Bill was read a second time on Monday last.

Runcorn.—The District Council last week received a report from Mr. T. L. Miller with regard to the supply of electricity in the district, but resolved to take no action in the matter at present.

Ryde.—At a special meeting of the Town Council on Thursday last week, it was decided to apply to the Local Government Board to borrow £30,000 for carrying out a scheme of electric lighting for the town. The scheme is based upon reports drawn up by Messrs. Kincaid, Waller & Manville.

Ryton.—At a meeting of the District Council last week a resolution was unanimously passed in favour of the Tyneside Electric Power Bill, and the chairman was deputed to attend at London and give evidence on behalf of the Council.

South Shields.—The Workhouse Electric Lighting Committee of the Board of Guardians last week reported in favour of the lighting of the workhouse by electricity at an estimated cost of £2,785, and recommended that, subject to the approval of the Local Government Board, the sum of £3,000 be borrowed to defray the cost. The report was adopted by the Board.

Skipton.—The Urban Council has decided to obtain the necessary powers to supply the district with electric light.

Stirling.—The Corporation formally inaugurated their electric works on Wednesday last week, when after the switching on of the light a large company was entertained to cake and wine. The works, which are in close proximity to the Caledonian railway, and connected thereto by a siding, are of a substantial character, and are constructed so that the capacity of the station can be doubled without any structural alteration. The engine room measures 52 feet 6 inches by 35 feet. The system of supply, under Prof. Kennedy's scheme, is that of low-tension direct current. In view of the possibility, however, of the Traction Company becoming a customer

of the station, certain modifications have been made which will ultimately fit in with the alterations that may be needed to cope with a traction load. Steam is got from two Lancashire boilers, at a working pressure of 160 lbs. per square inch, supplied with water by two Worthington feed pumps. These pumps are also connected with the economiser, which is capable of raising the temperature of 1,300 gallons per hour from 60° to 200° F. In the engine room the present plant consists of two 120-H.P. engines, and two of 40 H.P., all being of the Belliss fast-running and self-lubricating type. Each engine is coupled to a direct current shunt-wound dynamo, with drum armature. The larger machines have their magnets so arranged as to admit of a series winding for traction work. The switchboard has been designed to provide for the addition of controlling gear in the event of the tramways being converted. There are two storage batteries, each of 125 cells. The mains are on the three-wire system, and there are 30 Brockie-Pell arc lamps, of the single-carbon type, for public lighting. The prospects of the undertaking are very favourable.

Hammersmith.—At a meeting of the Vestry last week it was decided that as the Vestry had elected to spread the initial cost of the proposed additions and extensions of the electric light installation over a period of 42 years, they should replace any of the plant and machinery which might be necessary during that period, and during the currency of the proposed loan of £41,825, and provide for the same out of a sinking fund to be created for the purpose of such renewals or replacements, or out of the maintenance account.

Train Lighting.—The *Review of the River Plate* says:—"From a report recently made by Messrs. Preece & Cardew on the cost of lighting railway carriages by electricity, it appears that the total annual cost per coach would be £13 16s. 6d., based on the cost of fitting and running 400 coaches with an average of 12 lamps of 8 C.P. per coach. The total capital outlay for lighting this number of coaches is estimated at £32,000. These figures somewhat exceed those contained in a report on the same subject by Mr. Worby Beaumont some months ago."

Walsall.—The Corporation is applying to the Local Government Board for sanction to borrow £15,000 for electric lighting purposes, and an inquiry is to take place in regard to the application to-day.

The Corporation has decided that from and after the 25th inst. the charge for the supply of electric current for motor purposes shall be at the rate of 2½d. per unit for the first four hours of the maximum load, and 1d. afterwards, and the discounts to large consumers shall be abolished so far as current for motive power is concerned.

Whitby.—A Local Government Board inquiry was held at Whitby last Friday with reference to the District Council's application for leave to borrow £26,000 for electric lighting purposes.

Messrs. Preece & Cardew's report to the Lighting Committee of the District Council provides for the erection of a low tension electricity works at a cost of £18,500, capable of supplying 4,500 8-C.P. lamps and the lighting of the main streets with 32 arc lamps.

Winchester.—The Electric Light and Power Company now undertake to wire consumers' houses, free of initial charge, on consideration of an extra payment of ½d. per unit for energy. This is much below the usual charge.

Woking.—The District Council has come to terms with the Woking Electric Supply Company, Limited, with regard to the company's undertaking, practically on the lines of the Electric Lighting Acts.

Wolverhampton.—On Friday Mr. H. H. Law, Local Government Board inspector, held an inquiry at the Town Hall in reference to an application by the Corporation to borrow £11,000 for electric lighting purposes. Mr. Shawfield, the electrical engineer, explained that it was proposed to extend the electrical plant at the generating station to meet the increasing demands of the town. The extension included two 500-KW. generating sets, consisting of three-crank compound Willans engines, direct coupled to multipolar generators, giving an output of 200 amperes at 550 volts. The town clerk said the Corporation, in view of the increasing demand for electricity, had arranged that the plant must be installed before the winter of 1901. The inspector, at the close of the inquiry, visited the electric lighting station.

ELECTRIC TRACTION NOTES.

Baker Street and Waterloo Railway.—The engineers to the authorised Baker Street and Waterloo Railway have prepared, in compliance with the Standing Orders of Parliament, a detailed estimate of the cost of the proposed extensions and subways for which sanction is sought during the present session. The total cost is put down at £945,000, which includes a sum of £22,000 for general contingencies. The details of this expenditure are as follows:—

Proposed extension to Bishop's Road, Paddington, £378,000; proposed extension to Westminster Bridge, £31,000; proposed extension to the New Kent Road, Newington, £228,000; proposed extension to the Elephant and Castle, Southwark, £263,000; proposed subway at Bishop's Road, Paddington, £14,000; and the proposed subway at Newington to the Elephant and Castle station of the City and South London Railway, £9,000.

Birmingham.—Those who have followed the course of tramway events here during the past few years, will hardly believe that there is a serious leaning toward the overhead trolley system at last. Everyone who knew much about mechanical traction knew that it must come to this sooner or later, and it is to be hoped that there will be no further hitch. It is stated that the Tramways Sub-committee of the Public Works Committee met on Tuesday, all the members being present. A communication was received from Mr. Ross (chairman of the City of Birmingham Tramways Company) proposing a remodelling of the Bristol Road route on an electrical overhead system, which did not involve the provision of any capital by the Corporation. The lease of the Bristol Road route has about 11 years to run, and the company are, we understand, willing to do the work at their own expense without asking for an extension of the lease, but stipulating that at the expiration of the lease the Corporation shall purchase the rolling stock at a valuation. Various points of detail were open to objection, but the sub-committee were led to understand by Mr. Ross's representative (who was present at the meeting) that modifications would be agreed to as required by the committee. Subject to these modifications being accepted by Mr. Ross, the sub-committee determined to recommend the adoption of the proposal to the Public Works Committee, who were to meet yesterday. The vote was not quite unanimous, but the difference of opinion created by one member of the committee related to the method of traction. Mr. Howard Lane, in a lengthy communication to the chairman of the sub-committee, resigns his seat thereupon, because he doesn't like the trolley.

Brussels and Antwerp.—A project is announced for an electric service to connect Brussels and Antwerp without intermediate stoppages. It is stated that the distance from station to station, about 24 miles, would be covered in 20 minutes, or including the local service to the centre of each city, in 35 minutes.

Devonport.—A strong effort is to be made by the Devonport Corporation to provide the plant necessary for the supply of electricity for the tramways which the Devonport and District Tramways Company are laying down in the outskirts of the town. Under their agreement with the company, the Corporation ought to be able to supply current by next August. The erection of the generating station and the laying of the cables have, however, not yet commenced, and there is not the remotest prospect of the whole scheme—which combines lighting and traction, and is to cost £74,536—being carried out in time. In order to overcome the difficulty and keep faith with the company, the Electric Lighting Committee have decided to push on with so much of the work as is necessary for the working of the tramways. For this purpose a sum of £6,000 will be immediately laid out, and tenders are being invited for the remainder of the work. Alderman J. B. James, the chairman of the committee, informed the Town Council at their meeting last week that he had little doubt of the ability of the committee to fulfil their obligation to the company by the time stipulated. With regard to the general scheme, he expressed the opinion that although prices for material of all kinds were greatly enhanced, the Devonport scheme would, in point of cost, compare favourably with any electrical plant in the country. A little difference has been created by the General Tolls Company, the owners of road bridges across Stonehouse Creek, over which the Corporation cables will have to be laid. The Corporation are asking Parliament to give them power to assess the bridges for rating purposes, and the company in return decline to discuss the question of allowing the Corporation to lay their cables across the bridges. In this matter the Board of Trade is to be appealed to, and asked to issue a compulsory order.

Leicester.—A deputation from the Tramways Committee visited Sheffield to obtain information *re* the working of the electric tramways. They afterwards proceeded to Glasgow and Edinburgh for a similar purpose.

Middlesex.—The Light Railway Commissioners have been holding an inquiry at Westminster into the joint application of the North Metropolitan Tramways Company and the Middlesex County Council for permission to construct light railways to connect the present system owned by the London County Council at Highgate with the lines at Tottenham and Edmonton. Mr. Cripps, for the promoters, said the scheme would connect Central London and the outlying districts and join hands with the Hertfordshire scheme. The arrangement was that the Council should find all the money for the construction, and the repayment of interest and capital would not become any charge on the rates, as the company would pay it and provide the equipment, taking all the risk of the working. The lease to the company was to be for 25 years. The opposition of local authorities had been reduced to almost nothing. The railway companies did not oppose the scheme because they could not deal with the traffic. The population to be served by these lines was nearly 500,000. Mr. Vivian Cooper, the company's engineer, said the cost for their part of this scheme was £337,000. The opposition of the Hendon, Tottenham, and Southgate District Councils was withdrawn, but Mr. Wheeler, on behalf of the Finchley District Council, said this was a speculative scheme; the district was not ripe, and it would cost twice as much as had been represented. Mr. Asquith said there was no adequate evidence of public need for the scheme, and the damage and inconvenience which would be caused were entirely out of proportion to the benefits expected. He represented 750 frontagers and ratepayers.

Newport.—The Lighting and Traffic Committee advised the adoption of the overhead trolley system, but the chairman of the Electricity Committee quoted the views of Prof. S. P. Thompson regarding surface contact traction, with the result that the matter was referred back for further inquiries. It was pointed out that last year an elaborate report on surface contact traction was presented to the Council.

The Corporation Bill which has just passed the House of Lords Committee includes powers for the extension of the tramlines and for the erection of a power station for the working of the cars by electricity. There are two sites for the power station scheduled in the Bill.

Plymouth.—In connection with the Bill which is being promoted by the Plymouth, Stonehouse and Devonport Tramways Company for the conversion of the tramways connecting Plymouth with Devonport to the electric traction system, an arrangement has been come to under which that portion of the lines which is in the borough of Plymouth will become the property of the Corporation. The line will be laid on the 3 feet 6 inches gauge, which is the same as that of the Corporation tramways in Plymouth and the proposed electric tramways in Devonport. The reconstruction is to be carried out at the cost of the Plymouth Corporation, and the company are to have a lease of 21 years upon payment of a rental equal to 11 per cent. per annum on the capital outlay, while the Corporation are to be allowed running powers over the line. Another stipulation is that electricity is to be supplied by the Corporation, the company paying £1,450 per annum for a supply up to 100,000 units per annum. The terms have been approved by the Corporation.—Mr. S. J. Page, the chairman of the Tramways Committee, explained that the rental of 11 per cent. would leave a sufficient margin for maintenance, so that at the end of the 15 years the tramways would be in a thoroughly efficient condition. The company has agreed to the conditions, with the exception of the one as to the supply of electricity, which has not been definitely accepted.

TELEGRAPH AND TELEPHONE NOTES.

American Pacific Cable.—A Washington telegram informs us that the Senate Committee for Naval Affairs reports favourably on the Bill for the construction of a cable by the Government from San Francisco to Honolulu, to be extended hereafter to Manila.

Automatic Telegraphy between Calcutta and Bombay.—An Indian paper says that automatic telegraphy has been introduced between Calcutta and Bombay with the most satisfactory results, telegrams being transmitted at the rate of 120 words per minute in each direction. Although the distance traversed is nearly 1,300 miles it has been found possible to work direct between the two cities without requiring an intermediate repeating station. It is believed that this rate is the highest which has yet been obtained by direct working over 1,300 miles without translation. The Wheatstone apparatus has been installed and improved by Mr. F. Kuisman, B.Sc., of the Indian Telegraph Department. This gentleman retired on March 2nd, from active service, and has returned to England. The speed attained in England has been much higher, but the conditions are more favourable, and the distance much less. Automatic working has also been adopted with great success between Calcutta and Rangoon, in this case through several cables and many varying conditions of climate. Translation was therefore found necessary at Akyab.

The Cable Censorship.—The following announcement has been made by the Post Office:—

Her Majesty's Government have decided on a relaxation of the censorship at Aden to the extent that telegrams may be sent in code language to and from Zanzibar, Seychelles, Mauritius, Madagascar, British East Africa, German East Africa, and Lorenzo Marques, on condition that the codes, accompanied by translations of the code words, are deposited with the authorities at Aden. The translations must be either in English, German, Spanish, French, Dutch, Italian, or Portuguese. Each State may deposit two separate and distinct codes. The Postmaster-General has requested the Association of Chambers of Commerce to undertake the choice of the codes and translations which will be deposited on behalf of this country, and, as soon as they have been furnished, he will cause them to be transmitted without delay to Aden. The Government of the French Republic have already deposited with the authorities at Aden the A B C Code (4th edition) and the A Z Code; and it is now open to the public in this country to use these codes in messages to the places above specified. Notifications will from time to time be made to the public as further codes are deposited.

The Cape-Australian Cable.—In the *Times* and other London newspapers on 15th inst. a communication was printed under this title from Mr. F. E. Hesse, manager of the Eastern Extension, Australasia, and China Telegraph Company, publishing a statement with a view to remove "much misconception in Parliament and elsewhere as to the exact nature and extent of the arrangement about to be entered into by the Governments of New South Wales, Victoria, South Australia, Western Australia, and Tasmania with the Eastern Extension Company." The arrangement is stated as follows:—

1. For the company, in conjunction with the Eastern Telegraph Company, to provide at their own cost—estimated at about 1½ millions—direct cable communication between South Africa and Adelaide, which, with the third route recently established between Great Britain and the Cape, would give Australia an alternative communication to the existing route *via* India, Egypt, and the Mediterranean.

2. To at once reduce the existing tariff between Great Britain and the contracting Colonies (varying from 4s. 9d. to 5s. 1d. per word) to a uniform rate of 4s., with proportionate reductions for Government and press telegrams; and, as the traffic responds to the reductions, to further lower the tariff on a sliding scale down to 2s. 6d. per word.

3. On the laying of the Cape-Australian cable to reduce the tariff between Australia and South Africa from 7s. 1d. to 2s. 6d. per word.

In return, the Eastern Extension Telegraph Company only acquire the right of direct dealing with the public in the capitals of Australasia when the proposed Government Pacific, or other competing cable, is laid. This right has always been enjoyed in Great Britain, not only by British, but foreign telegraph companies, and is recognised in Canada, South Africa, and elsewhere.

A reply to this, signed "M. H. G.," London, appears in the *Times* of 19th inst. The writer says that:—

Mr. Hesse gives no information concerning the effect of such an agreement if carried out, the enclosed letter and report recently written by the Postmaster-General of Queensland, will serve to remove, in Parliament and elsewhere, misconceptions which might arise, owing to want of general knowledge, as to the effect of the agreement which Mr. Hesse's company look forward to concluding.

The letter from the Postmaster-General at Brisbane (James G. Drake) is dated February 1st, 1900, and the report on the company's proposal is dated October 12th, 1899.

As was to be expected, the Canadians take a very keen interest in the realisation of this scheme; this is evinced in the following telegrams:—

Ottawa, *March 14th.*

The annual meeting of the British Empire League was held here to-day, when resolutions were adopted in favour of State-owned cables connecting Great Britain and the Colonies, the speedy completion of the Pacific cable, and the formation of a Canadian Naval Reserve. Mr. Mulock said that it would be nothing less than a national calamity if anything occurred to block the Pacific cable scheme.

Ottawa, *March 16th.*

The Senate to-day adopted, on the proposition of Sir Mackenzie Bowell, a resolution containing the following words:—

"Serious delays having occurred in the prosecution of the Pacific cable undertaking through the hostility of the Eastern Extension Company, which is now demanding concessions from Australia that, if granted, will imperil its success, this House is of opinion that any further delay in proceeding with the construction of the cable will be inimical to the interests of the Empire, and strongly deprecates granting further concessions to the Eastern Extension or any other companies."

Ottawa, *March 19th.*

In the House of Commons to-day Mr. Casey quoting the Hansard report of the debates in the Victorian Assembly for February 9th, said it was evident that Mr. Chamberlain approved the proposed Australian concessions to the Eastern Extension Cable Company. Mr. Mulock, the Postmaster-General, doubted the accuracy of the report, but said that, even if it were correct, communications between the Imperial and the Dominion Governments indicated a change in the situation since then, and that the report did not agree with the Government's impression of the present attitude of the Imperial authorities. He added that he yet hoped that the scheme would be successfully carried out.

In Queensland and New Zealand feeling in favour of the Pacific cable is equally strongly expressed. We learn that in Brisbane recently a deputation from the Chamber of Commerce waited on the Postmaster-General in connection with the probable effect on the Pacific cable of the proposals of the Eastern Company, the deputation strongly supporting the Pacific cable scheme. The Postmaster-General, in reply, said it had been consistent with the policy of the Government of Queensland for 25 years past to advocate the construction of a Pacific cable. Certainly it was much to be regretted that just now, when it seemed the construction of the cable was on the eve of accomplishment, that the Eastern Company should come forward with a scheme which was manifestly intended to destroy the chance of the Pacific cable being gone on with. The fact that the company was willing to make the concessions was an example of the value of the monopoly which they now had a chance of losing. They had agreed to give, when they found themselves in danger of losing it, what they had refused to give before. The Queensland Government would countenance no proposal which would jeopardise the Pacific cable. Regarding the position taken up by New South Wales, he did not think the people of New South Wales were unanimous in the views expressed by the Postmaster-General. Mr. Drake did not think the New South Wales Government would go in direct opposition to the views of the majority of the people in Australia. As to whether the Queensland Government would be prepared to stand alone with New Zealand and Canada, he would lay that view before his colleagues, but he could say on behalf of the Government that Queensland would stand with Canada and New Zealand to get the Pacific cable proceeded with at the earliest opportunity.

The following is from the Queensland press:—

The Premiers have done right in imposing conditions on their acceptance of the proposal of the Eastern Extension Company to lay a cable to connect Australia with South Africa. The qualifications are not apparently of importance, but the right to open local offices in the Colonies, and to receive and deliver their cable messages, seems to be stoutly contended for by the company. That really means a not inconsiderable subsidy, and we trust the Premiers will be steadfast in refusing it, although the company's Australian representative, Mr. Warren, has already declared that his company cannot accept the alterations. And in notifying his refusal, Mr. Warren takes the opportunity of reminding the Colonies that the company's 21 years' subsidy expired in October last, and that when the existing tariff agreement expires in August next, they will be in a position to increase their transmission rates in any way they choose. That looks very much like a threat, and we say by all means let the company raise its tariff, for no surer way could be suggested of getting immediate steps taken for the laying of one or more competitive cables. Some stimulant of this kind appears to be requisite to arouse general interest in this important question.

The *St. James's Gazette* of Wednesday, under the title "Pacific Cable Obstruction," says:—

Sir Robert Herbert is, we believe, an able man; and we rejoice that the Colonial Office has at its disposition one so well acquainted with the spirit of the Colonies. But this Empire of ours comprises numerous Colonies, and a fear has been expressed that Sir Robert's zeal is too largely directed to the welfare of one. It is only natural that, as an Australian ex-premier and director of the Eastern Telegraph Company, this adviser of Mr. Chamberlain should believe that the Pacific cable is by no means a pressing necessity. Nor is it strange, in view of the handsome offer made by the Eastern Extension Company to the Australian Colonies to construct a Cape cable, that Australian Colonies should also see it in that light. The consequence is that a very pretty quarrel is looming up between Canada and Australia. The latter appears to somewhat lightly hold its promise of support to the Pacific cable, and the former is very resentful at the prospect of longer and still more damaging delay. The Colonial Office has its work cut out to smooth over matters, but we hope a sacrifice of the cable will not be the result.

The above extract from the *St. James's Gazette* is not correct in describing Sir Robert Herbert as a director in the Eastern Telegraph Company. He is a director in the Eastern and South African Telegraph Company (which is practically owned by the Eastern Company) and chairman of the Telegraph Construction and Maintenance Company. Sir Robert Herbert was Under-Secretary of State for the Colonies from 1871 till 1892, and for some time Agent-General for Tasmania. This, and the fact that he was Premier of Queensland from 1859 till 1866, and that he is at present Chancellor of the Order of St. Michael and St. George, would naturally give his opinion great weight in the Colonies.

Claim by the Cuba Submarine Cable Company.—A Central News message states that the Cuba Submarine Cable Company has presented to the United States War Department a claim for $4,000 for the damage done to the company's lines when they were cut by the American vessels in the late war. The company also claims the subsidy of $10,000 a year which it received from the Spanish Government, and which was to be paid up to 1910.

Code Telegrams.—The second edition of the official vocabulary for code telegrams is now approaching completion. The first of the four volumes has already been issued by the International Telegraph Conference, and the remaining volumes will appear at intervals of a few months. The work will contain about 1,300,000 words, and may be obtained on application to the secretary at the General Post Office, at a charge of £3 4s.

Glasgow Telephones.—The Corporation has decided to lease from Messrs. G. & J. Maclachlan, for a period of 28 years, the two topmost storeys of a building which is in course of erection at the corner of Renfield Street and West Regent Street, Glasgow. The premises so leased are to be used as the exchange in connection with the Corporation telephone system. It is expected that the building will be ready by September 1st. The rates for the Corporation telephones will be £5 5s. per annum, or, on the toll system, £3 10s. per installation, with a penny per call extra. Intending subscribers will have the option of choosing whichever system they prefer.

The London County Council and the Telephone Service.—The National Telephone Company has addressed a circular to members of the London County Council regarding the company's request for permission to lay underground wires. After describing the negotiations with the Council that have been going on since June, 1896, the circular says:—

The company has pointed out to the Council that now that its demand for competition has been answered affirmatively, the company will be placed at great disadvantage with its competitor, the Postmaster-General, if it is denied powers to put down plant which the Postmaster-General possesses, and the Council has replied that it is ready to give the requisite consent on two conditions:—

1. That the company will supply the service on the same terms as the Postmaster-General, whatever those terms may be; and
2. That the company will permit the Postmaster-General's subscribers to have free inter-communication with those of the company.

The company in answer has said that it will accept the first condition, but that the second is impossible of acceptance.

On the 1st ult. I wrote to the clerk of the Council stating that the company was willing to agree to the principle of inter-communication upon the lines which the Telegraph Act of last year and the Postmaster-General's order thereon imposes for the provinces. This letter was considered by the Highways Committee of the Council, and the answer I received was, "the Committee is not prepared to recommend the Council to consent to the provincial terms as to inter-communication between the two systems being applied to London." The demand of the Council for free inter-communication by a competitor commencing business is equivalent to asking that a new railway a few miles long should have free running powers over the whole of the London and North-Western system.

There the matter now stands, except that the County Council has commenced an action against the Company with the view of obtaining an injunction restraining the company from maintaining its existing underground wires, some of which have been laid down with the consent of the Council, and all with the consent and approval of the local authority.

Lowestoft Telephones.—Mr. B. Whaite, the East Coast District Manager of the National Telephone Company, recently attended a meeting of the General Purposes Committee and discussed with the Committee the matter of wayleaves for underground telephone cables. It was resolved that the town clerk be instructed to confer with Mr. Hawtayne on the whole matter and report to a future meeting of the Committee. The English Industrials, Limited, wrote saying that they intended to bring out a telephone company to conduct telephone business at low rates, and asking the Council to pass the following resolution:—"That this Council will support the English Industrials, Limited, of Manchester, in their application for a telephone license, and that wayleave facilities may be afforded the same company on conditions to be hereafter mutually arranged." The Committee recommended that the Council should pass the resolution as asked.

Mr. Jefferies said the Committee would welcome competition. Mr. Orde asked what were the terms of the English Industrials. The town clerk said the terms proposed were 50s. per instrument, plus ½d. per call, with a maximum of £6 5s. per annum.

Mr. Orde moved that the matter go back to the Committee for further consideration. The charges of the two companies were so nearly alike that he did not think it worth while to have two services. The National Telephone Company were serving them very well. The Committee's recommendation was passed.

New Cable.—The *British Australasian* says that cable communication between Rottnest Island and the mainland is likely to be established soon. The material which was ordered by the Government at the latter end of last year was, in February, on board the steamer *Suffolk*, which had arrived at Fremantle from London, and as soon as it could be landed a start was to be made with the work of laying the cable. The line is a twin-wire telephone cable, and was manufactured at the Silvertown Cable Works. It is said to be 13 miles in length, there being 4 miles of shore end cable and 9 miles of intermediate deep sea cable. The cable weighs 120 tons, and it was shipped in a large iron tank filled with water. Mr. Cakebread was to superintend the work of laying on behalf of the Silvertown Cable Works.

Telegraph Matters.—The Associated Chamber of Commerce had before them last week a number of questions relating to telegraphic communication, and passed a resolution advocating the placing of electrical communication between the United Kingdom, India, and the colonies and dependencies on a footing commensurate with the greatly altered conditions of inter-Imperial and colonial relations. A resolution regarding the excessive Anglo-French telegraph rates was also passed.

Telegraphic Convention with Russia.—In the House of Commons on 15th inst. Sir J. Leng, on behalf of Sir E. Sassoon, asked the Secretary for India whether he had any information to the effect that the Telegraphic Convention with Russia has been renewed by the Indo-European Company on the basis of a return of 17½ per cent. to the Government from the gross earnings of the company, and whether this arrangement had been concluded with the knowledge of and after consultation with the Indian Government, as one of the joint purse partners. Lord G. Hamilton, in reply, said that he had no information as to the renewal of the agreement between the Indo-European Company and the Russian Government, nor had the Indian Government, so far as he was aware, been consulted on the subject.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1891 duplicate)	Oct. 23, 1899 ...	...
Mole St. Nicholas-Cape Haitien...	March 6, 1900 ...	...
New York-Hayti	Feb. 26, 1900 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Cayenne-Paramaribo	Feb. 16, 1900 ...	...
Ceara-Maraham	Feb. 20, 1900 ...	...
Para-Maraham	March 2, 1900 ...	...
Coro-Maracaibo	Mar. 15, 1900 ...	...
Djedda-Souakim	March 13, 1900 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Sitia-Rhodes...	Mar. 17, 1900 ...	...
Tarifa-Tangier	Jan. 2, 1900 ...	...
Landlines.		
West Indies:—		
Communication with Port de Paix (Haiti)	Feb. 26, 1900 ...	...
South African:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communications with Bloemfontien	Oct. 18, 1899	Mar. 20, 1900
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Communication beyond Burghersdorp (Cape of Good Hope) ...	Nov. 7, 1899 ...	...
Communication beyond Estcourt (Natal)	Nov. 7, 1899 ...	...
Communication with Bluefields (Nicaragua)	July 7, 1899 ...	...
Communication with all offices of Colombia	Oct. 23, 1899 ...	...
Communication with Colombia beyond Buenaventura	Jan. 22, 1900 ...	...
Communication "*vid* Hanekine" interrupted on Persian Territory	Feb. 24, 1900 ...	...
Coro-Maracaibo	Mar. 15, 1900 ...	...
Serena-Valparaiso	Jan. 16, 1900 ...	...

Telegraphic Rates to South Africa.—In the House of Lords on Tuesday the Earl of Lichfield asked whether the reduction to 2s. a word given by the Eastern Telegraph Company for outward messages could be extended to home messages sent by the troops in South Africa. The Marquis of Lansdowne in reply said, that the Eastern Telegraph Company have agreed to give a special rate for home messages as well as outward messages. Lord Strathcona asked if the concession would be extended equally to Her Majesty's Canadian and Australian soldiers and to those from the other outlying parts of the Empire—from which contingents had been sent to South Africa. The Marquis of Lansdowne did not like to commit the Eastern Telegraph Company, but he would make inquiries. The Eastern Telegraph Company had shown such a desire to meet the wishes of the Service that there was every reason for hoping that this desire would be met also.

Telephonic Communication with the Continent.—The Associated Chambers of Commerce have expressed the opinion that the time has now arrived when some effort should be made to establish telephonic communication with Germany, Holland, Belgium, and other Continental countries, and they will apply to Her Majesty's Postmaster-General with this view.

Turkey and Telegraph Concessions.—Reuter's Constantinople correspondent, writing under date March 17th, says:—

Last year the Sultan issued an Iradé granting, in principle, to a German group authority to lay a cable between Kustendje, in Roumania, and Constantinople. This concession is considered to have been a deliberate violation of the firman of the Eastern Telegraph Company, which specifies that the company shall have prior rights in the laying of any cable between Ottoman ports or between Ottoman and foreign ports. The Eastern Company, therefore, supported by the British Embassy, lodged an energetic protest against the Iradé in question with the Porte, insisting on the recognition of its rights. The matter remained in abeyance for some months, the Porte not making any satisfactory reply to the Cable Company's protest. A few days ago, however, the Germans approached the Imperial Government with a view to settling details regarding the landing of the cable, as the group is now almost ready to take the work in hand. The Germans affect to disregard absolutely the protest of the Eastern Telegraph Company, which they say concerns only the Ports. They contend that the Eastern Company cannot lay the line failing the consent of the Roumanian Government, which has made exclusive arrangements with the German group, and that therefore the claim of the British company to prior rights falls to the ground. The Germans feel confident that they will induce the Porte to overrule the privileges of the Eastern Company, and the course of the next week or so will show whether their efforts will be successful or not.

What Telegraph Clerks Would Like.—The twentieth annual Conference of the Postal Telegraph Clerks' Association opened on 14th inst. at Newcastle-on-Tyne. The programme of demands for discussion by the Conference included an advanced scale of remuneration with a maximum of £200 per annum, after passing a technical examination; promotion by efficiency, good conduct, and seniority; a seven hours' day, with overtime calculated at the rate of 42 hours per week; the annual holiday to be confined to the eight months between March and October, with 21 days' leave; superior appointments in the Postal Department to be open to telegraphists; retirement to be optional any time after 50 years of age on two-thirds pay, and compulsory at 60; the right of combination; and compulsory overtime to be limited to six hours weekly.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium. — March 28th. Tenders are being invited until 28th inst., by La Société Nationale des Chemins de Fer Vicenaux of Brussels, for the supply of a battery of accumulators for use in connection with a system of light electric railways in the Liège district. Tenders to be sent to the company, 26, Rue de la Science, Brussels, whence particulars may be obtained.

Blackpool.—March 27th. The Tramways Committee wants tenders for 15 electric tramway cars. See "Official Notices" March 16th.

Cardiff.—April 3rd. The Corporation wants tenders for the wiring and fitting up for electric light the new Fish Market in the Hayes, Cardiff. Particulars, &c., from the electrical engineer, Eldon Road, Cardiff, deposit one guinea.

Christiania. — April 4th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Christiania, stating that tenders are invited by the Norwegian State Railways Administration, not later than April 4th, 1900, at 2 p.m., for the supply of 475 tons of steel rails with their accompanying fishplates. Particulars may be examined on application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Corunna. — April 15th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Corunna, stating that tenders are invited by the Corunna Electric Co-operative Society for the supply of a complete set of electrical machinery of 400 H.P., and capable of supplying 12,000 lamps of 10 C.P. All necessary information can be procured from the secretary, Senor Dr. Enrique Sors, 81, Calle Real, Corunna. Tenders should be addressed to the President, Senor Dr. Manuel Baifa, Calle Zafateria, No. 5, Corunna, before April 15th.

Crete.—April 7th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Canea, Crete, stating that tenders are invited by the Cretan Government, not later than April 7th, for the construction and working of tramway lines between Canea and the suburb of Halepa, and between Canea and the new Government offices. Such particulars as have been received may be examined on personal application at the Commercial Department on the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Dartford.—March 27th. The Urban District Council is inviting tenders for the supply of Lancashire boilers, pipework, surface condenser, two high speed steam dynamos and motor boosters, batteries, switchboard, overhead traveller, mains, conduits and roadwork, arc lamps and posts, and station lighting. See "Official Notices" March 2nd.

Doncaster. — March 28th. The Corporation Market Committee is open to receive tenders for lighting the Corn Exchange by electricity. Specification, &c., from the Resident Electrical Engineer, 3, Priory Place.

Dublin.—April 26th. The Electric Lighting Committee wants tenders for six Lancashire and four water-tube boilers and two economisers; two 1,000-KW. and two 500-KW. low speed polyphase generators for the electricity supply scheme. See "Official Notices" March 9th.

Durban (Natal).—April 2nd. The Corporation is inviting tenders for 1,900 tons of steel girder rails, 64 tons of fishplates (bolts, bonds, &c.), 407 loads Australian hardwood stringers, &c., also the laying of same for 14·36 miles of single track, and bonding 2·96 miles of equivalent existing single track, the Corporation laying concrete foundations and making up roadway. See "Official Notices" February 9th.

Edinburgh.—April 7th. The Corporation wants tenders for the supply of coal, arc lamp carbons, cast-iron pipes, pavement box frames, &c., for the electricity supply stations for 1900-1901. See "Official Notices" to-day.

France.—April 5th. The French Post and Telegraph Authorities in Paris are inviting tenders until April 5th, for the supply of 762,000 porcelain insulators, in eight lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et Telegraphes, Rue de Grenelle 103, Paris.

Halifax. — April 7th. Tenders are being invited for electric lighting work for the Victoria Concert Hall and premises. See "Official Notices" March 16th.

Keighley.—March 31st. The Corporation wants tenders for wiring the new municipal offices now erecting. See "Official Notices" March 16th.

Maidstone.—April 3rd. The Corporation wants tenders for steam and water pipes and valves for electric lighting works. See "Official Notices" March 16th.

Morpeth.—April 7th. Tenders are wanted for a complete electric lighting installation for the County of Northumberland Lunatic Asylum, near Morpeth. See "Official Notices" this week.

Russia. — April 13th. Tenders are being invited until April 13th, by the municipal authorities of Wilna, for the concession for the construction and operation of a central electric lighting station in the town. Tenders to be sent to Darkmagistrat of Wilna, whence particulars may be obtained.

Salford. — April 9th. The Corporation wants tenders for an ash conveyor and two electrically-driven travelling cranes, for the new electricity works. See "Official Notices" to-day.

Southampton.—April 7th. The Harbour Board invites tenders for a motor transformer with accessories. See "Official Notices" March 16th.

St. Anne's-on-the-Sea. — March 23rd. The Council wants free wiring proposals. See "Official Notices" March 16th.

Stockholm.—March 29th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Stockholm, stating that tenders are invited by the Administration of Royal Swedish Telegraphs for the supply of certain telephone cables. Particulars on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Sunderland. — March 20th. The Corporation wants tenders for india-rubber covered cables, wrought-iron and cast-iron piping, and box frames, and covers, for the electricity undertaking. See "Official Notices" March 16th.

Walthamstow.—March 23rd. The Council wants tenders for the supply and laying of electric lighting cables. See "Official Notices" March 9th.

CLOSED.

Aberdeen.—The Tramways Committee report that the electrical engineer received tenders for the supply of four electrical cars for the Woodside route, and the electrical equipment of three horse cars, with spare parts of electrical and mechanical equipment. The committee recommended that the offer of Macartney, M'Elroy, and Co., Ltd., amounting to £3,900, be accepted, on condition that the equipment is to be Westinghouse motors, &c., Brill trucks, Brush car bodies, and that they undertake to complete the whole of the contract within six months from the date of acceptance.

Bath.—At a recent meeting of the Town Council the following tenders were accepted on Mr. Metzger's recommendation:—For cables (high and low tension), Messrs. Callender's tender of £7,357 0s. 8d.; for arc lamps, posts, and accessories, Messrs. Lucy & Co., Oxford, their No. 618 post and British Thomson-Houston lamp, £2,991; for transformers, the British Electric Transformer Company, £458 8s.; sub-station switchboards, Messrs. Cowans, Limited, Manchester, £236; main works switchboards, the Westinghouse Company, £1,918 18s.

Beckenham.—Messrs. Le Grand & Sutcliff have received a contract for sinking two trial bore holes for the Council electricity works.

Belfast.—The Council has accepted the tenders of Messrs. Mather & Platt and Messrs. Johnson & Phillips for dynamos were accepted.

Brighton.— It is proposed to place the order for a combined feeder and dynamo switchboard for the electricity works with the Edison & Swan Company at £502.

Cardiff.— The Corporation has accepted the tender of Messrs. John Williams & Sons, Cardiff, for supplies to the electric light department.

France.—The French Post and Telegraph authorities in Paris recently invited tenders for the supply of a large quantity of telephone cables, and has placed contracts as follows:—M. G. de la Mathe, of Gravelle—St. Maurice, 100 kilometres of gutta-percha insulated and lead-sheathed double conductor cable at 63,000 fr., and 25 kilometres ditto., but with seven conductors, 80,000 fr.; M. A. Grammont, of Pont de Cherny, 13 kilometres of lead-sheathed 3-conductor cable at 88,080fr.; La Société Industrielle des Telephones of Paris, 42 kilometres ditto., but with seven conductors, at 155,106 fr.; and the India-Rubber Gutta-Percha Company, of Persan-Beaumont (Seine-et-Oise), 14 kilometres ditto. at 60,270 fr.

Glasgow.—The Electricity Committee recommend acceptance of the following tenders:—Messrs. Mecban & Sons, fitting up copper bus bars at Port Dundas Station, £370; Messrs. J. & W. Aitken, executing foundation settings for the additional boilers and engines to be put down within Port Dundas Station, £196; Messrs. G. & J. Weir, Limited, direct-acting feed pump for Kelvinside Electricity Station, £100; Messrs. Joseph Wright & Co., a patent Berryman feed-water heater at Kelvinside Electricity Station, £418.

Messrs. A. & P. Steven, are to construct the electric lift for the new Fine Art Galleries, at a cost of £515 10s.

Ilford.—The District Council has accepted the following tenders in connection with the proposed electricity supply works:—For water-tube boilers with fittings, economiser, feed pumps, &c., Messrs. Babcock & Wilcox, £3,471.—Pipe work, &c, in engine and boiler house, Messrs. Babcock & Wilcox, £1,296; two 200-KW, and one 100-KW. steam dynamos and motor boosters, (vertical enclosed high speed engines), General Electric Company, £5,324.—Storage batteries, Electric Power Storage Company, £1,750. It was also resolved that an agreement be entered into for the maintenance of the batteries for three years at £405, the Council to reserve to themselves the right of option to change it to five years for £675, should they so desire. Main switchboard and connections, with marble panels, Messrs. James White, £1,387 11s. 6d.. One 15-ton engine crane, Southgate Engineering Company, £317 10s. Underground mains, conduits, and roadwork for public and private lighting, Henley's Telegraph Works Company, £24,636 10s. 5d. Arc lamps and posts, Messrs. Verity's, Limited, £2,671. Station lighting, Mr. L. G. Tate £83. The total of the accepted tenders amounts to £41,341 11s. 11d.

Inverness.—The Town Council has accepted the tender of the Brush Electrical Engineering Company, Limited, for electricity works, amounting to £21,000.

London.—The Shoreditch Vestry on Tuesday received the following two tenders for the supply of two additional boilers for the electric light station:—

Babcock & Wilcox, Limited, London	£1,650	Haythorne Tubular Boiler Syndicate, Ltd., Glasgow	£2,400

The tender of the first-mentioned firm was accepted subject to the approval of the Vestry's electrical engineer.

The following tenders for the annual contracts were accepted:—

ENGINEER'S STORES: W. H. Willcox & Co., and Hunns & Co.
IRONMONGERY AND TOOLS: J. E. & S. Spencer, and F. Bird & Co.
ELECTRICAL SUNDRIES: Johnstone, Benjamin & Co., the Edison & Swan Co., and Williamson & Joseph.

The tender of Messrs. Storrs, Sons & Co. was recommended for the erection of the chimney shaft at the new generating station at the sum of £5,499 less £600 allowed for old buildings on the site. This was postponed.

Newington. — The Vestry has accepted the tender of Messrs. Babcock & Wilcox for the supply and erection of two additional boilers at the station, feed pump, iron work, and the extensions to the steam and water mains, including chain-grate stokers and superheaters, at £9,461.

Stoke-on-Trent.—The Guardians' Building and Estates Committee received between 30 and 40 tenders for installing the electric light at the workhouse. As advised by the engineer, they had not thought it expedient to accept the lowest tender, and recommended that the tender of the Lancashire Dynamo and Motor Company, of Manchester, amounting to £1,600, be accepted, also the tender of Mr. G. Margetts, of Manchester, for the wiring and accumulators, at £1,126. The work in accordance with these tenders would be carried out at a cost of £2,726, or £674 less than the estimate of the electrical engineer. The report was adopted by the Guardians.

FORTHCOMING EVENTS.

Friday, March 23rd. — At 5 p.m. Physical Society. Agenda:—1. "An Electro-magnetic Experiment," by Prof. S. P. Thompson, F.R.S.; 2. "Some Experiments illustrating Syntony," by Mr. P. E. Shaw; 3. "An Electrical Micrometer," by Mr. P. E. Shaw.

At 9 o'clock — Royal Institution of Great Britain. Sir Andrew Noble on "Some Modern Explosives."

Saturday, March 24th.—The Manchester Association of Engineers. Paper by Mr. W. Heap, Manchester, "The Tool Room. (*a*) For the Manufacturer; (*b*) for the Engineer."

At 3 p.m.—Royal Institution of Great Britain. Third lecture on "Polarised Light," by Lord Rayleigh.

Monday, March 26th.—At 8 p.m. Society of Arts. Fourth Cantor lecture on "Photography of Colour," by E. Sanger Shepherd.

At 11 a.m.—Institution of Electrical Engineers. Students' visit to the works of Messrs. Easton, Anderson and Goolden, Limited.

Wednesday, March 28th.—At 7.30 p.m. Institution of Electrical Engineers. Students' Meeting. Paper on "Electricity Meters," by R. Lloyd Pearson (Student).

Thursday, March 29th. — At 3 p.m. Chemical Society. Annual general meeting. Presentation of the Longstaff medal to Prof. W. H. Perkin, jun., F.R.S. At 8.30 p.m. the Bunsen memorial lecture will be delivered by Sir Henry E. Roscoe, F.R.S., Vice-President.

Friday, March 30th.—At 8 p.m. Electro-Harmonic Society. Last smoking concert for the 1899—1900 season. Café Monico.

Thursday, April 5th. — At 8 o'clock. Institution of Electrical Engineers. Meeting.

At 8 p.m.—Civil and Mechanical Engineers' Society. Prof. A. Sharp, B.Sc., Wh.Sc., A.M.I.C.E., on "Fly-wheel Accidents."

At 8 p.m.—The Röntgen Society. Ordinary meeting, paper on "The Influence of the X Rays upon the Growth and Development of Micro-organisms," by Dr. Norris Wolfenden and Dr. Forbes Ross.

Friday, April 6th.—At 9 p.m. Royal Institution. "Solid Hydrogen," by Prof. Dewar, F.R.S,

Monday, April 23rd.—At 8 o'clock. Institution of Civil Engineers. The eighth "James Forrest" lecture, by Sir William Preece, K.C.B., on "The Application of Electricity to Engineering."

CURRENT SPECIFICATIONS.

II.—DARTFORD ELECTRIC LIGHTING.

SUMMARY.

System.—Direct current three-wire, with a pressure of 460 volts between outer conductors at dynamo terminals.

Output of Engines.—A normal load of 100 KW.

Output of Dynamos.—A normal load of 100 KW., but see comments below for output under special conditions.

Speed Specified.—Not to exceed 460 revolutions per minute.

Time of Delivery.—To be stated in offer.

Stipulations as to Wages paid to Workmen.—Those generally accepted as "current for competent workmen" in Council's district.

Stipulations as to Removal of Foreman.—Very stringent. See comments below.

Penalty for Late Delivery.—One per cent. for first four weeks, 2 per cent. for further periods. See comments below.

Arbitration.—Provided for. See comments below *re* scope of same.

This specification, prepared by Mr. W. C. C. Hawtayne, M.I.E.E., asks for plant for a complete electric lighting scheme for the town of Dartford.

As it is expected that eventually electrical energy for both lighting and traction purposes will be required, the three-wire low tension direct current system has been adopted, the dynamos being provided with an over-compounding coil to render them suitable for traction work.

The first instalment of generating plant will consist of two 100-KW. steam dynamos. The manner in which these are specified leaves little to be desired, the requirements are clearly stated, and no manufacturer can complain that insistance upon details debars him from offering his standard plant. The only points tenderers must bear in mind are the heavy overloads asked for, viz., 25 per cent. over normal full load for periods of one hour, and in the case of the dynamos it is not clearly specified whether this overload is on the normal output of 100 KW., or whether, when working on a traction load, it is on 200 amperes, in which case the total overload will far exceed 25 per cent. It is specified that the temperature rise of 60° F. after a full load run of six hours shall be measured by the resistance method. This is very stringent, many consultants allowing 80° F., or even more, when using this method of determining the final temperature.

We note that tenderers for storage batteries are asked for maintenance offers for the cells up to 100 per cent. of their rated capacity for different terms of years. That such a course of action is possible proves the confidence which manufacturers have in the types of cells now on the market.

The general conditions are, in the main, drafted on the lines of the standard clauses agreed upon between the Municipal Electrical Association and the Electrical Plant Manufacturers' Association, but it is quite possible that misunderstandings may arise on the following points unless care is

taken by tenderers to make their position clear when sending in offers.

Thus in Clause 4 we have the following:—

Tenders *may* be sent in for one or more complete sections of the work, as described in the advertisement, a copy of which is given above, and persons tendering must fill in the summaries at the end of each section tendered for, and the reference space on the cover. No tender will be considered that includes only a portion of the work under any section.

Any person *tendering for the works comprised in one section may in addition to sending in distinct and separate tenders, also send a lump sum tender for the works included in any of the sections for which he also tenders separately.*

So far as this goes it seems clear, but it does not define what is the final contract sum, a matter of great importance to the contractor when we come to consider Clause 28, which reads:—

In case *the contract or the works and things to be done thereunder or any part thereof, shall not be completed by the contractor within the time appointed for the completion thereof* in Condition 27 *the contractor shall pay as liquidated and ascertained damages*, and not by way of penalty to the Council, out of any money which shall then be or may become due to him from the Council, notwithstanding any purported assignment thereof, 1 *per cent. of the contract value of the works for each and every week or fraction of a week up to and including the first four weeks* which shall elapse between such appointed time and the actual completion of the contract; *and after the expiration of such first four weeks*, 2 *per cent. of the said contract value for each and every week or fraction of a week* which shall elapse as aforesaid. And the Council may deduct any amount which may accrue to them under this condition from any amounts due or becoming due from them to the contractor, or they may proceed to recover the same from the contractor by action at law or otherwise as they may be advised.

If the contract is let in sections the meaning is clear, the "*contract value of the works*" for which each contractor is responsible is *the value of his particular section*, while if *more than one*, say, for the sake of argument, *the whole of the sections* are successfully tendered for by one contractor, there is certainly room for doubt.

It may be stated either that each section stands or falls by itself, or that the *total value of the whole contract* is the sum upon which penalty is to be calculated. If the latter is the true rendering, and the plant in one section alone is late, the Council may demand and the contractor must pay a far larger sum as penalty than in the former case, though the inconvenience and loss to the Council is the same.

Another objectionable feature is the graduated penalty it is intended to impose, *one per cent.* per week on contract sum for first four weeks late, and *two per cent.* per week thereafter. As we pointed out last week, the maximum permissible penalty agreed upon in conference between the two Associations above mentioned was *one per cent.* per week, and it is very usual to only demand *one-half of one per cent.* per week. We suggest that strong exception be taken to this point.

We have an arbitration clause which is practically identical with the standard draft, but there is one stipulation in the general conditions which seems to withdraw certain acts of the engineer from any possibility of revision; thus Clause 5 reads:—

After the contract has been signed, *the decision of the engineer* in regard to the meaning of the aforesaid plans, or of any dimensions, word, clause, sentence or otherwise in the general conditions, specifications and plans, *shall be final and binding on all parties.*

It should be made quite clear that this clause must be interpreted in conjunction with the general arbitration clause No. 36. The only other point upon which we wish to comment is contained in Clause 22, which states:—

The contractor shall, in the execution of the said works, employ skilled workmen in their various trades and callings, and shall immediately *dismiss* any person employed by him in the execution of the works who shall misconduct himself or be incompetent or negligent in the performance of his duties, and such person shall not be again employed on any portion of the works. The engineer shall have the right to require the immediate removal, either temporary or permanent, of any such person, and the contractor shall comply with such requisition.

We recognise that it is just and fair that the engineer should have the power claimed in the last clause, viz., to require the removal of any worker against whom he has due cause of complaint; but we urge that it is going quite outside his province to ask for power to force an employer to *dismiss* an employé, who the employer knows under other conditions of working would prove quite satisfactory. It is a demand which we consider unjust and unfair, and when once its true character is understood we feel sure that its enforcement or inclusion in any formal contract will not be pressed.

NOTES.

Electrical Engineers for the Front.—The active service company of the Electrical Engineers Royal Engineers left Chelmsford, where they have been mobilised, last Friday morning by a special train at 5.30 a.m. In spite of the early hour a large crowd assembled in the streets and at the station to wish them good-bye. The proceedings commenced about 4.30 a.m., when the "night shift" from Messrs. Crompton's works marched *en masse* through the town to the station. From this time onwards the crowd rapidly grew in proportions, the numbers being increased by the members of the "day shift," who had been allowed an extra half hour on this special occasion. A torchlight procession, with band, accompanied the troops from their temporary barracks, in Springfield, to the station, the heartiest of good wishes being everywhere expressed by the people, who, in spite of the cold and early hour, thronged the streets. On the platform were assembled the relatives and friends of those going out, all the members of Messrs. Crompton's staff, the officers of the local volunteer corps, the members of the Arc Works Pupils' Club, and others. The train, which was also conveying Paget's Horse, from Colchester, was punctual, and the troops quickly entrained. Cheers were given for "The Electrical Engineers," "Captain Lloyd," and "Lieutenant Pott," and counter-cheers by the troops for "Chelmsford." The train moved off to the strains of "Auld Lang Syne," and the proceedings terminated with "God Save the Queen" in the orthodox manner. The Electrical Engineers sailed in the transport *Tagus*, from Southampton, later in the day, and we feel sure that our readers will join with us in wishing them "God speed and a safe return."

The *Morning Post* says that the War Office has approved a proposal for a further detachment of Electrical Engineer Volunteers to be formed for South African service. Another engine with dynamo and a couple of waggons is to be provided for the use of the corps.

Horis Pattison and Bathurst v. The National Telephone Company, Limited.—This case was in the list for hearing before Mr. Justice Buckley in the Chancery Division on Wednesday last. Before the case was called on, Mr. Astbury, Q.C., for the plaintiff, said that the action was brought against the defendant company for a mandatory order compelling them to remove 610 wires which were put over the plaintiffs' premises and attached to the roof. Mr. Stokes, for the defendants, had, on behalf of his clients, agreed to consent to judgment, and therefore all he (Mr. Astbury) should ask for now was a mandatory order and an inquiry as to damages.—Mr. Stokes said he would agree to this, and asked for seven days' time in which to comply with the order.—Mr. Astbury agreed, and his Lordship made the order asked for, and gave the plaintiffs the costsup to and including the judgment.

Prussian Academy of Sciences Bi-centenary.—This anniversary was celebrated by a meeting, at the invitation of the Emperor, at the Royal Castle, Berlin, amid a noble display, on Monday last. A number of decorations in honour of the occasion were awarded, and we are pleased to note that several British scientists and scholars were elected members of the Academy. Among these were included Lord Kelvin, foreign member; and Sir John Burdon Sanderson, corresponding member.

Information Wanted.—Mr. R. Ley Alkin writes from Leeds as follows:—"Can you kindly inform me of any firm in the kingdom making cast-iron commutator segments to gauge? The ones I am using at present are cast dead to gauge, absolutely free from blow-holes, and cast with any form of lug required. These I have, however, to get from America, the length of time in delivery being the only drawback."

The Trolley Car in China.—A Chicago exchange quotes from the *Cleveland Plain Dealer* as follows:—

English and Japanese capitalists have the franchise for the first electric railway in the Flowery Kingdom. The railway will be three miles in length, and the street along which it will run is one of the most densely populated in the world. The Chinese have no objection to electric railways.—From late telegraphic news.

Cleal um tlack foh tlolley!
Look out foh 'e' tlain!
Whizzee longee lailway,
Up and back aglain.
Chinee likee lidee—
Nose wantee pay.
Stealee on 'e' platfiom,
Gettee pletty gay.

Likee muchee 'lectlic,
Makee lottee spalk,
Allee samee fliwok,
Catchee in 'e' dalk.
Chinee pickee wi' up,
Lookee likee clam;
Chinee yellee "Hellee!"
Sayee muchee dam!

Cleal um tlack foh tlolley!
Heal um bellee ling!
Chinee no can catchee—
Gonee to Tien Tsing.
Chinee likee tlolley,
Likee go inside;
Savee up he cashee—
Thence takee lide!

Rivals.—The *Journal of Gas Lighting* appears to be wearied by reading that this, that and the other fire has been caused by gas, or gas explosions, for he yawns quite pitifully in a would-be critique of the recent fire at Maiden Lane electricity works. In our mind's eye we can see the occupant of the editorial chair pull himself together and rub his hands quite gleefully as he reads the account in the technical journals describing the effects of the fire. He seems to fairly gloat over the opportunity of breaking the monotony of gas explosions and having a hit at electricity supply works. He strives hard but unsuccessfully to prove that the Maiden Lane occurrence was caused by electricity. As we stated a fortnight ago there was not one iota of evidence to that effect; but there *has* been overwhelming evidence of mishap upon mishap, fire upon fire, fatality upon fatality, in connection with gas supply where gas has been the direct cause, and this sad fact has, perhaps, inclined the *Journal* to hypercriticism. We have not room to deal with the comments in detail, but we content ourselves with merely taking exception to a sentence which says that "indispensable assistance was rendered to the distracted engineers at the station by the district officers of the Gas Light and Coke Company, who, being appealed to, lent lamps, and gave all the help in their power to Mr. Patchell in his emergency." This we believe to be nothing less than a fabrication, for careful inquiry has failed to reveal any foundation whatever for such a statement. The gas company were not appealed to, nor did they lend any lamps. The writer says "Tell us the exact origin of the fire, and confidence in electricity supply works will be in a measure restored." Really, it is agreeable to find that our gas contemporary ever placed confidence in anything but its own antiquated system of illumination; and it is certainly entertaining to read "what might have been" if so-and-so had been something else instead of what it happened to be.

Municipal Trading.—Lord Avebury opened a discussion on this subject at the monthly dinner of the London Chamber of Commerce, held at the Trocadero on Wednesday.

In the House of Commons the same evening Mr. Balfour said that he could not yet name a day for the consideration of the motion for the appointment of a Committee on municipal trading.

Polarised Light.—Last Saturday Lord Rayleigh delivered the second of his series of lectures on "Polarised Light" at the Royal Institution.

General Post Office.—Mr. H. R. Kempe has been appointed Principal Technical Officer, Engineer-in-Chief's Office, in the place of the late Mr. M. Cooper.

A Critic's Error.—The *Municipal Journal* in its last issue takes to itself credit for the decrease of £25,000 in the profits of the City of London Electric Lighting Company for the year 1899, as compared with 1898. We have not the least objection to our esteemed contemporary doing this, for nothing pleases it better than to oppose, in one way and another, electrical progress by private enterprise. The *M. J.* is again railing at the City company for high charges for current, notwithstanding the reductions which have been made recently. The writer maintains that "there is still plenty of scope to lower them," but as we read further on we gather that, for private lighting, the company is selling two Board of Trade units or more for the price of one copy of our contemporary, viz., 1d.! Two units a penny should be low enough, in all conscience, and there is no municipality that can beat such a record. We are told that last year the company "sold 74,447,031 units for private lighting, for which it obtained £160,411 15s. 9d." We may not believe it, of course, but our contemporary should see that its figures are in keeping with its contention as to high charges before it flings its diatribes abroad.

Lectures.—At the Royal Albert Institute, Windsor, last week, Mr. A. B. Harding lectured on "Electric Waves and Wireless Telegraphy."

At the British Schools, Eastwood, on 14th inst., a lecture on "The Use of Electricity in Mines," was delivered by Mr. Charles Latham.

Sir W. H. Preece lectured in the Albert Hall, Sheffield, on 16th inst. on "Ætheric Telegraphy."

On Friday last a lecture was delivered at Chudleigh Town Hall, on "Practical Electricity and Hypnotism."

A meeting of the Royal Society of Edinburgh was held on 19th inst., Lord Kelvin, president, in the chair. Dr. Alexander Galt submitted a third and concluding communication in his present research on the "Heat of Combination of Metals," towards the expenses of which the British Association for the Advancement of Science had given a grant of £20. The combinations tested were principally alloys of copper and zinc, there being 22 of these containing portions of copper varying from 5 to 90 per cent.

Bailie Mackenzie, convener of Electric Lighting Committee of Edinburgh Town Council, read a paper on "The Progress of Electric Lighting in the United Kingdom" to members of the Edinburgh Association of Science and Arts on Monday night. He said that the success at Edinburgh was brought about by selling at a cheap rate, thus obtaining a large turnover.

Before the Ipswich Engineering Society last week, Mr. H. S. Jefferies, one of the vice-presidents, read a paper on American Workshops, their Machinery, American Competition, &c.

Personal.—Mr. H. Core Gardner will continue the patent business of his late father under the old style, "H. Gardner," at 166, Fleet Street, E.C. Mr. H. C. Gardner is a duly registered patent agent, and has been in the Fleet Street business for many years past.

The employés of the Consolidated Telephone Company, Coventry, on 17th inst. presented Mr. W. J. M. Menzies with a beautifully framed testimonial as a token of the high esteem and regard in which he was held by them during the 15 years of his association with them as general manager of this company, which position he relinquished some months ago.

Mr. R. M. Carr has been appointed assistant electrical engineer to the Bexhill-on-Sea Urban District Council.

Appointments Vacant.—A mechanical draughtsman is required for the electricity works at Islington at £134 per annum. See "Official Notices" to-day.

A mains superintendent is wanted at £130 a year for Southampton. See "Official Notices" to-day.

The Institution of Civil Engineers.—The annual dinner was held on Wednesday evening in the Merchant Taylors' Hall, Sir W. H. Preece presiding.

(*Continued on page* 493.)

THE WILLESDEN ELECTRICITY WORKS OF THE METROPOLITAN ELECTRIC SUPPLY COMPANY, LIMITED.

Probably since Mr. Ferranti startled the electrical world by erecting what were then comparatively huge electricity works at Deptford, and transmitting electrical energy 5 miles to London at the unprecedented pressure of 10,000 volts, no more important undertaking has been carried into effect in this country than that which we describe below. No more eloquent testimony to the vast growth of electric lighting in recent years could be desired, than that afforded by the fact that, although the company possesses as many as *five* generating stations in various parts of its area of supply, it has been found necessary to provide additional generating plant of capacity equal to that already installed in these stations, in order to cope with next winter's demand; while the extension scheme contemplates the ultimate increase of the new works to six times their present size!

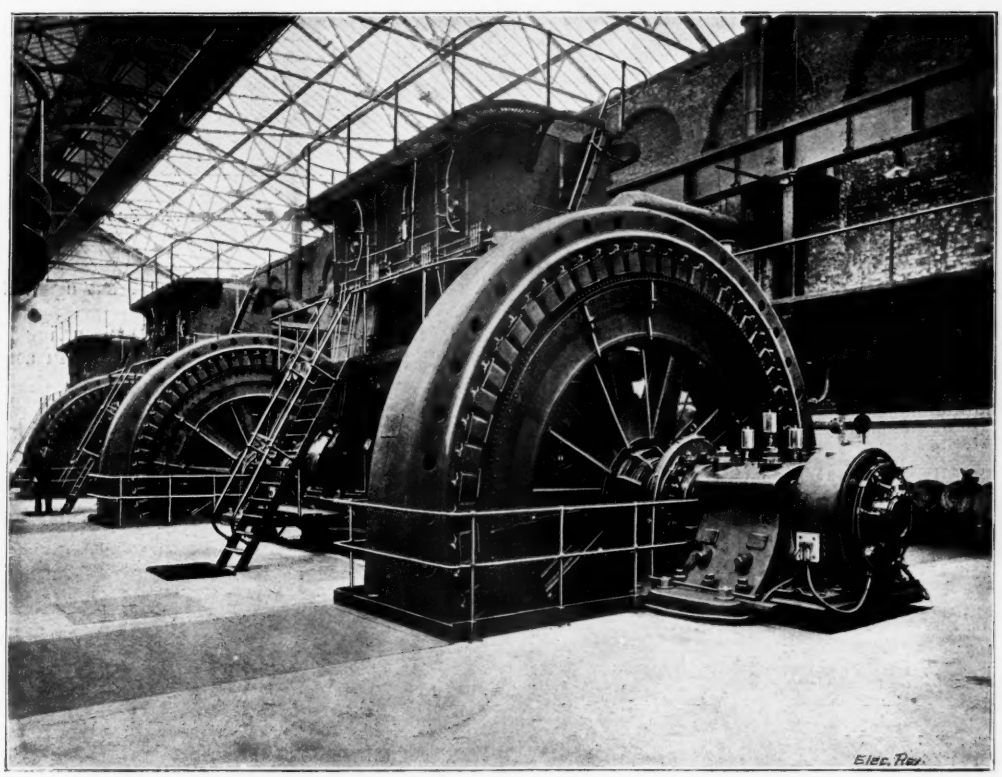
The works have been erected on a site of about 9½ acres belonging to the company, partly in Willesden and partly in Acton; access to it is readily obtainable by the Midland and the London and North-Western Railways, and the Grand Junction Canal, which bound three sides, while the fourth side is formed by Acton Lane. The site is, therefore, an ideal one as regards accessibility.

A siding from the London and North-Western Railway and a wharf on the canal bank have been provided, from either of which coal can be unloaded and carried into store by means of a Temperley transporter, of which we shall give a view on a later page; the coal store is of large capacity, and is intended to form a reserve for all the generating stations belonging to the company.

The arrangement of the buildings, as at present erected and as planned for future extensions, is shown on the plan overleaf. They will eventually comprise a central engine room 384 feet long by 112 feet wide, in two bays, flanked on either side by a boiler house, 384 feet by 88 feet. There will be four chimney shafts, each 165 feet high and 13 feet 6 inches in diameter, of which one is already built.

The whole of the ironwork was carried out by Sir Wm. Arrol & Co., while the brickwork was undertaken by the company itself.

The present boiler house is 164 feet long by 88 feet wide. The boiler plant now at work consists of two rows of eight Babcock & Wilcox water-tube boilers, fitted with superheaters; eight of these are provided with Vicars mechanical stokers, two are to be equipped with Babcock & Wilcox stokers, and the remainder are at present hand fired. The coal bunkers, of about 1,000 tons capacity, are situated over the gangway between the boilers, and are filled by means of the Temperley transporter; the coal is fed to the boilers by means of hoppers and shoots. Ashes and clinker from the boilers fall down inclines into trucks under the boiler room floor, which are removed and tipped into barges by means of the transporter. Each boiler has a heating surface of 3,500 square feet, a grate area of 62 square feet, and has 160 tubes $3\frac{15}{16}$ths inches in diameter. The working pressure is 160 lbs., but the boilers are all built for 200 lbs. per square inch, and tested to 350 lbs. The stokers are driven by two Chandler enclosed engines, connected by means of clutches, so that either can be run and the other held in reserve.



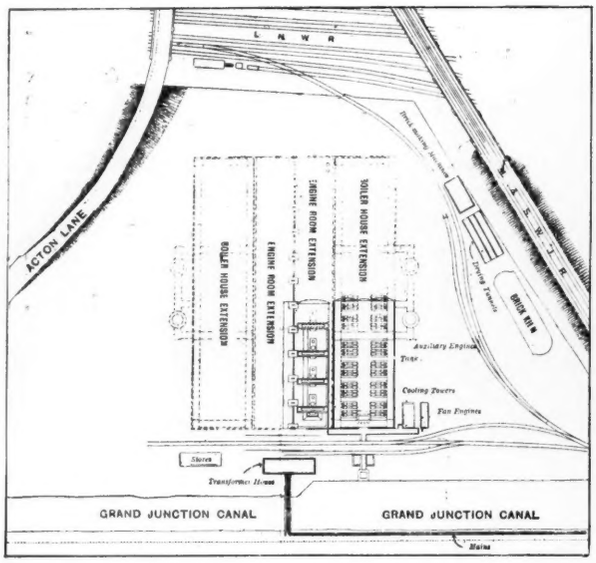
Generating Sets and Exciters.

Both steam and feed pipes are arranged on the ring system in the boiler house; the former are of steel, with heavy loose flanges, and the joints are made with copper rings.

The engine room is at present 176 feet 6 inches long, by 72 feet wide, and 36 feet high to the eaves. The main roof, of glass and iron, is braced in all directions, and spans 57 feet; the remaining width is covered with a temporary roof, the material of which will be made use of when the engine room is enlarged to its final dimensions. The wall next the boiler house and that at the south end are of brick, but the remainder of the construction is, for the most part, iron. The north end is, in fact, closed by a huge galvanised iron screen, which is provided with wheels, and will be used again and again as the engine room is extended longitudinally.

The foundations of the generating sets are concrete blocks 19 feet thick. The material removed was found to be of excellent quality for brick-making purposes, so the company proceeded to turn what would otherwise have been a serious incumbrance into a valuable asset by putting

down a complete brick-making plant of the most modern type, including a Belgian kiln, Bastin brick-making machinery, and drying tunnels. The bricks will be used by the company in carrying out the extensions of the works.



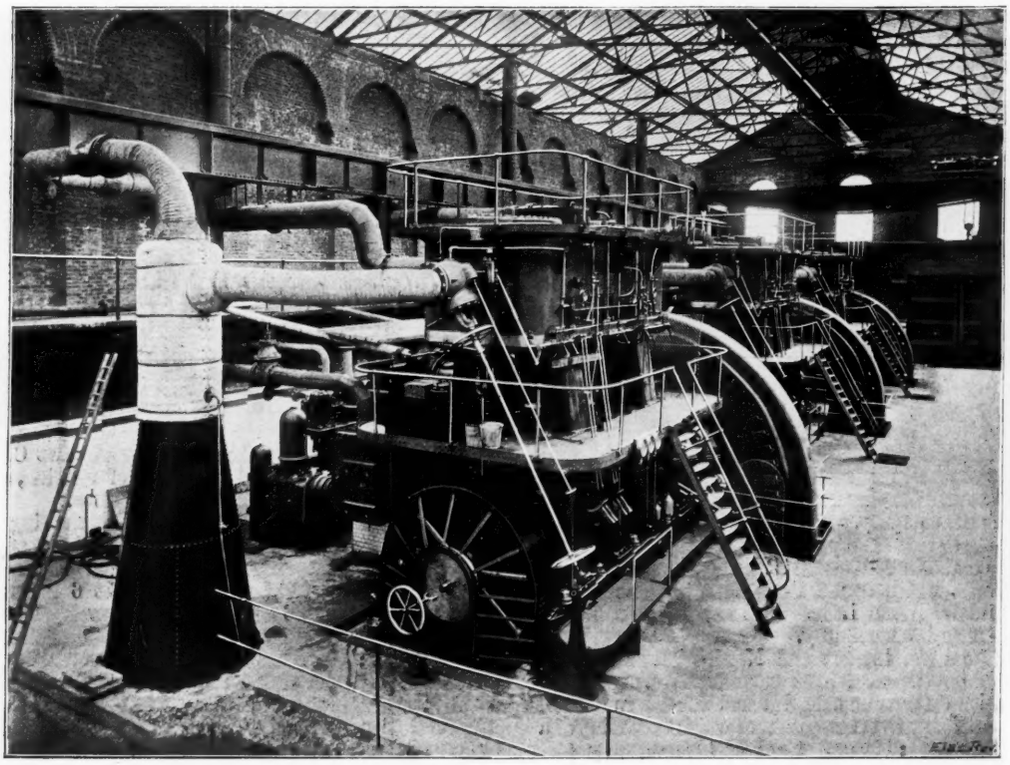
Plan of Works.

The engine room is served by an electric travelling crane, made by Messrs. Higginbotham & Mannock, capable of lifting 30 tons. A single motor is used, mounted on the crab, and taking current from bare copper wires stretched across the crane.

The generating plant already in position consists of three 1,500-kw. sets, while a fourth is on order to complete the present installation. Eventually there are to be no less than 18 sets of the same size. Each set consists of a 2,500 H.P. Westinghouse engine coupled direct to a Westinghouse two-phase alternator, the engine being entirely on one side of the latter. The most striking feature of the engines is their massive construction; they were, in fact, primarily designed for strength and absolute reliability of working. As we gave a number of particulars of these and of the generators, in our issue of the 16th ult., we need not again describe them at length.

Low Pressure Room and Subway.

The governors are of the fly-wheel type, acting direct on the high pressure valve, and varying its travel in accordance with the load; the low pressure piston valves are in duplicate, and are actuated by a single fixed eccentric. The governors have not as yet been adjusted for parallel running; they are, in fact, too sensitive for that purpose. This, however, can easily be remedied. When running to assist

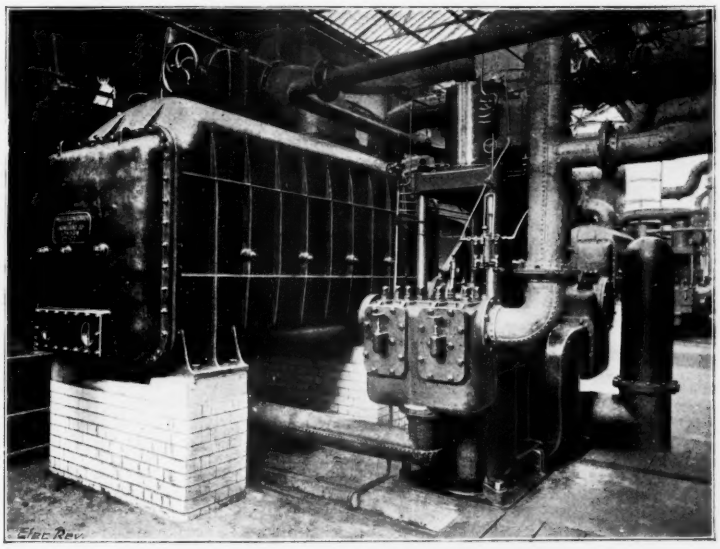


General View of Engine Room from Switchboard Gallery.

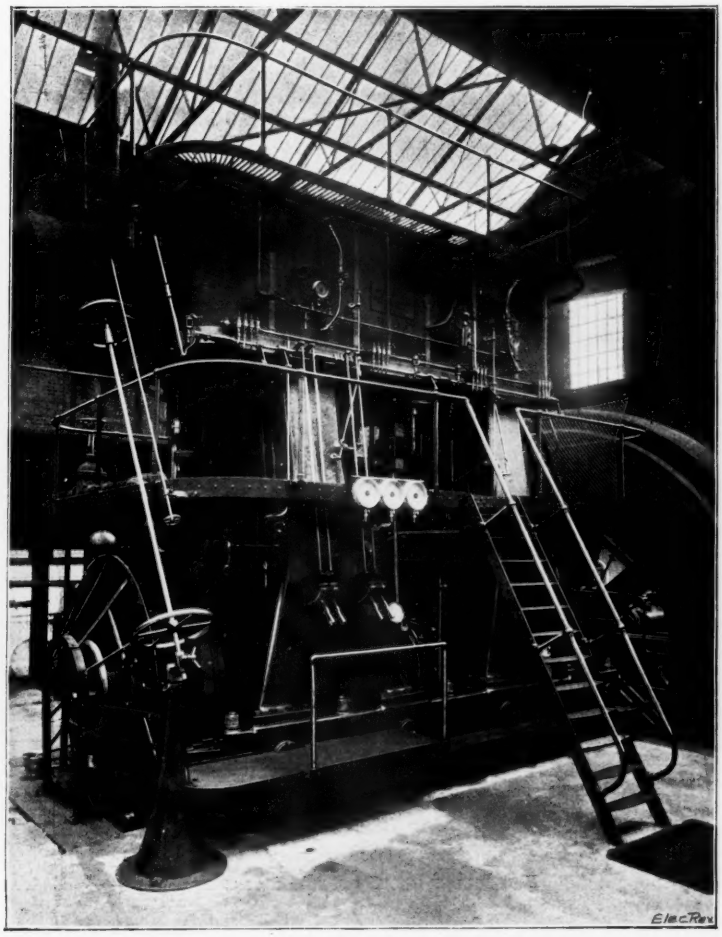
the older stations the speed is 145 revolutions per minute, corresponding with 75 periods per second; the frequency will be lowered later on to 60, when the engines will run at 116 revolutions per minute. The higher frequency is at present employed in order to approximate, as nearly as the conditions permit, to the frequency of the older machinery, viz., 100 periods per second.

The alternators are of a most interesting description; the armature, which forms the flywheel of the combination, is 16 feet in diameter, and weighs 60 tons. The two halves of the 42-pole field magnets weigh 29 tons each without the winding, which in itself is no small item. The armature is wound with 552 bars, arranged in three separate closed circuits; there are, therefore, in all 12 leads from the periphery of the armature to the collector rings, and the three circuits are put in parallel by the connection with the latter. It may be remarked that, if it were desired to obtain direct currents from these machines, it would only be necessary to provide a commutator and couple it up to the existing winding, which would then be of the triplex series drum type! This brings home the fact that alternators and dynamos are fundamentally the same machines. A special feature of these armatures is the admirable ventilation; spaces are left in the core at about 3 inches pitch across the face, through which a powerful current of air is propelled by the rotation of the armature, and we were assured that the temperature rise of the winding was practically *nil* after long runs at heavy load. The output of the machines has been rated with a very wide margin, as they have been run at 1,800 KW. for long periods without the slightest difficulty. The exciting power at full load is 150 amperes at 100 to 105 volts, or about 1 per cent. on the output; the commercial efficiency of the machines, which is guaranteed to be 95 per cent., has not as yet been tested.

To guard against breakdown of the exciters, an auxiliary storage battery has been installed in a room over the transformer chamber, which can be brought into action at a moment's notice. There is also a direct current supply available from the auxiliary direct current light and power plant in an adjoining building. Not a single electrical hitch has occurred in any part of the generating, transforming and transmitting system since the new generators have been at work, with the slight exception of one or two fuses blowing.



Condenser and Pumps.

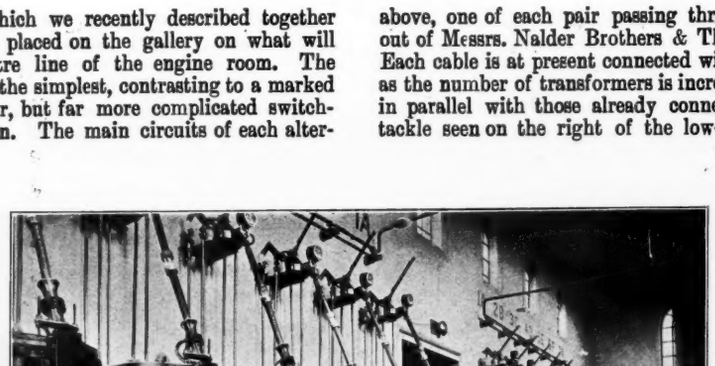


2,500-I.H.P. Vertical Compound Engine.

Each engine is provided with a separate set of condensing plant, consisting of a Wheeler surface condenser and a Blake double-acting air and circulating pump, driven by steam, the pump barrels being 22 inches diameter, and the two single-acting steam cylinders 12 inches diameter, with 18 inches stroke in each case. Each condenser has 4,000 square feet of cooling surface. The circulating water is cooled by means of three Barnard cooling towers, also supplied by the Wheeler Condenser and Engineering Company, each measuring 12 feet 3 inches by 12 feet by 37 feet high; each of these is designed to cool 80,000 lbs. of water per hour from 130° to 80° F. The hot water is allowed to drip down mats of galvanised wire netting, in opposition to a current of air produced by double fans, 10 feet in diameter, driven by Chandler compound engines at 125 revolutions per minute. Baffle plates are fixed between the fans in order to divert the draught into the proper direction.

For boiler feed-water there are three Blake vertical duplex compound pumps, exhausting into a feed-water-heater.

The switchboard, which we recently described together with the generators, is placed on the gallery on what will eventually be the centre line of the engine room. The apparatus thereon is of the simplest, contrasting to a marked extent with some smaller, but far more complicated switchboards that we have seen. The main circuits of each alternator are controlled by a single four-pole switch, two ammeters and wattmeters, and three automatic circuit breakers. The latter number is necessitated by the fact that the armatures are wound in closed circuit; for the same reason, only one of the four bus bars is earthed. The excitation of each machine is controlled by a double-pole throw-over switch, ammeter, and two rheostats — one in the exciter field, the other in the alternator field circuit. Pilot and synchronising lamps are also fixed on the board, and three swing-arm voltmeters for general purposes.



Transformer Room.

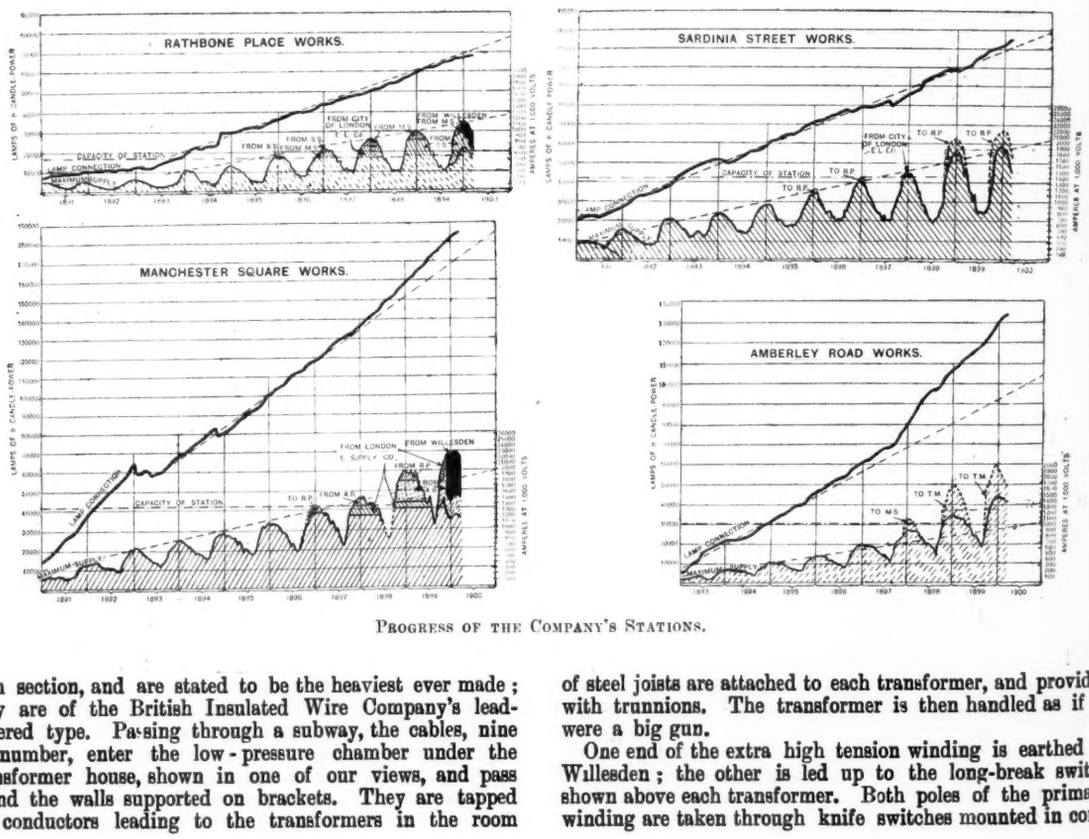
The bus bars are built up of copper strip on edge, 3 inches × $\frac{1}{8}$th inch × 5, partly for convenience in extending, and partly to avoid the increased inductive resistance that would occur if the bars were solid.

The mains from the switchboard to the transformer room and to the alternators are two-wire concentric, of 1 square inch section, and are stated to be the heaviest ever made; they are of the British Insulated Wire Company's lead-covered type. Passing through a subway, the cables, nine in number, enter the low-pressure chamber under the transformer house, shown in one of our views, and pass round the walls supported on brackets. They are tapped by conductors leading to the transformers in the room above, one of each pair passing through an automatic cut-out of Messrs. Nalder Brothers & Thompson's manufacture. Each cable is at present connected with one transformer, but as the number of transformers is increased they will be joined in parallel with those already connected. The barrels and tackle seen on the right of the low-pressure chamber form part of the "mains discharger," to which we refer later.

In the high pressure room, which is immediately above the other, are installed 12 step-up transformers of 250 KW. each; two more are about to be erected. The whole of the transformers, step-up and step-down, on the Willesden system are of the Berry type, made by the British Electric Transformer Manufacturing Company. The transformation ratio of the step-up transformers is 500 to 10,500 volts, and the efficiency is 98 per cent. at full load at the normal frequency of 60 periods per second. The voltage drop at full load is less than 1·5 per cent., and the power factor at no load is over 0·72.

Each transformer is 2 feet 9 inches in diameter by 6 feet 3 inches high, and weighs about 4 tons. It is mounted on a stout under-carriage of steel joists, with massive rollers, so that it can be moved about with ease. For transport, a pair of steel joists are attached to each transformer, and provided with trunnions. The transformer is then handled as if it were a big gun.

One end of the extra high tension winding is earthed at Willesden; the other is led up to the long-break switch shown above each transformer. Both poles of the primary winding are taken through knife switches mounted in com-



Progress of the Company's Stations.

bination with the extra high tension switch, and all three are operated by a lever on the floor level. These features are shown in our view of the transformer room.

Every transformer is subjected to the following tests :—A pressure of 15,000 volts is applied for half an hour across the E.H.T. coil, one pole being connected with the H.T. winding and the frame of the tranformer ; and a pressure of 2,000 volts is applied for the same length of time between the H.T. coil and the frame.

As will be seen, none of the transformers are enclosed in cases ; to this fact and to the thorough ventilation provided, not only in the core but also in the winding, the remarkably cool running is ascribed. A temperature test shows the rise after 12 hours' run at full load to be only 40° C. above the air. This is due entirely to the natural circulation of air through the transformer, as no artificial cooling device is employed.

(*To be continued.*)

PROGRESS OF THE METROPOLITAN ELECTRIC SUPPLY COMPANY'S STATIONS.

The curves which we reproduce herewith form the analysis of the combined curve which we gave last week in connection with the report of the company's meeting. From these it will be evident how hard pressed the company was last December, when the Willesden works were overdue, and every other station was loaded practically to its utmost capacity ! That every effort was made to cope with the demand by co-operation between the various works is obvious from the way in which, say, Sardinia Street helps Rathbone Place, while Rathbone Place passes on a supply to Manchester Square, and so on ; in some cases it even appears as though two stations simultaneously supplied each other ! The lamp connection in the Amberley Road district appears to have grown most rapidly, while this station is also the only one which has had a surplus of power throughout. The completion of the Willesden plant for running must have been hailed with immense relief by the various resident engineers, coming as it did, just in time !

NOTES.

(*Concluded from page* 488.)

Correction.—We are informed by Mr. A. S. Barnard, city electrical engineer to the Corporation of Hull, that the Allen-Parker steam dynamos, which we described last week, were installed in the Sculcoates Lane electric lighting station, and are used for lighting only.

Alexander v. Automatic Telephone Company, Limited.—In the Court of Appeal on Tuesday this case was heard on appeal by the plaintiffs from a judgment of Mr. Justice Cozens-Hardy. The question was as to the liabilities of certain directors to pay allotment money due on shares held by them. The case had not concluded when the Court adjourned.

The War—An American View.—The London correspondent of the New York *Electrical World and Engineer* delivers himself as follows under the heading "The War's Silver Lining" :—

There is no cloud without its silvery lining, and the old adage is being rather forcibly brought to the minds of Englishmen at the present moment. It is the impression of many thinking men that when the unfortunate war which England is waging is all over, a lasting benefit will have been derived, not in the ordinary commercial sense, but because it will have led Englishmen to see more clearly their own great deficiencies. Though England is agitated to its very centre at present by the news from South Africa, many are already hoping that the very suffering the country is experiencing will be the means to at last awaken England to a realisation of its lack of scientific methods, not merely in its army equipments or its military attainments, but as to nearly all the sciences and arts. England to-day is not a scientific nation ; it does nothing on scientific plans, and what attempt is made to advance like other nations is generally choked off by opposition. The newspapers and magazines criticise the lack of science shown in almost all branches of trade, and particular attention has been called by able writers to the backwardness of England in its electrical developments. Other countries are far more advanced in electric lighting, traction, and telephone service. It is not because there are not good engineers in England, but on account of the stupid opposition that every engineering scheme encounters, and the mass of rules and regulations and "red tape" that have to be overcome, and the conditions imposed by Parliament. The English might truly be said to be their own worst enemies. The easy-going self-satisfaction of Englishmen as to England and English methods has been the worst evil the country knows. It is getting a rude awakening now, however, and it is to be hoped that the lessons of the war will be taken to heart. There is still too much of the idea left that what was good enough for the forefathers is good enough for us. Some of our best manufacturers long ago opened their eyes to the fact that England does not "know it all," and have been for years freely purchasing machinery and tools from the United States and other progressive countries. Such manufacturers are successful, and are making progress, but many others, it is to be regretted, are still blind to the lessons to be learned, and will not adopt more modern and scientific methods. It is therefore on this account, and for these reasons, that it is hoped that after the war is all over and England has recovered its equilibrium, a careful analysis will be made of the whole condition of the economic principles governing in this country, and that the younger element will make the path easier for those who are willing and eager to introduce new and scientific methods of manufacture, of transport, or of lighting. It is a tremendous work to look forward to, but it will have to be done if England is to retain the leadership which she has enjoyed for so many years.

NEW COMPANIES REGISTERED.

Bryan Donkin & Clench, Limited (65,329).—This company was registered on March 12th, with a capital of £120,000 in £10 shares (3,600 first preference and 1,400 second preference), to acquire the businesses of "Bryan Donkin & Co., Limited," the "Donkin Land Company, Limited," and "Clench & Co., Limited," and to carry on the business of mechanical, mining, and electrical engineers, wire drawers, ironfounders, manufacturers of guns, arms, rolling stock, tools and implements, &c. The first subscribers (each with one share) are:—B. Donkin, The Mount, Wray Park, Reigate, M.Inst.C.E. ; E. B. Donkin, Woodside Grange, Lower Addiscombe Road, Croydon, engineer ; H. J. Donkin, Newlands, Leatherhead, engineer ; F. Clench, Lincoln Works, Chesterfield, engineer ; G. McD. Clench, Lincoln Works, Chesterfield, engineer ; A. G. Webb, 69, Barrow Road, Streatham, S.W., secretary ; and G. Clark, Spital, Chesterfield, engineer. The number of directors is not to be less than four nor more than six ; the first are Bryan Donkin, Edward B. Donkin, Frederick Clench, Harry J. Donkin, and G. McDakin Clench ; qualification, £5,000 ; remuneration £200 per annum, divisible.

Quincey Photographic Development Company, Limited (65,352).—Registered on March 14th, with a capital of £4,000 in £1 shares, to adopt an agreement with S. Quincey, and to carry on the business of photographers, lithographers, printers, photo-lithographers, manufacturers of photographic plates, apparatus, and appliances, manufacturers of and dealers in dynamos, wire cables, lamps, and electrical appliances, and materials, &c. The first subscribers are :—J. Bilbie, 80, Queen Victoria Street, E.C., engineer (with 100 shares) ; R. T. Adams, Halstead House, St. Ann's Road, Tottenham, photographic apparatus maker (with 100 shares) ; W. D. Gooch, 2, Willes Road, N.W., consulting engineer (with 25 shares) ; A. Fox, 1, Eade Road, Finsbury Park, builder (with 25 shares) ; A. I. Frozley, 640, Seven Sisters Road, N., fancy dealer (with 25 shares) ; F. T. Rushton, 14, New Inn, W.C., solicitor (with 1 share) ; and J. R. Orellin, 74, Empress Avenue, Ilford, Essex, gentleman (with 1 share). The number of directors is not to be less than three nor more than seven. The first are :—S. Quincey, and others to be appointed by the subscribers ; remuneration £50 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kensington and Knightsbridge Electric Lighting Company, Limited (26,193).—This company's annual return was filed on March 7th, when 15,000 ordinary, 10,000 first preference, and 10,000 second preference shares were taken up out of a nominal capital of £350,000 in 50,000 ordinary, 10,000 first preference, and 10,000 second preference shares, all of £5 each ; £5 has been called up on each of 10,000 ordinary, 10,000 first preference, and 9,131 second preference, and £1 10s. on each of 869 second preference ; £146,958 10s. has been received ; 5,000 ordinary shares are considered as fully paid.

Smithfield Markets Electric Lighting Company, Limited (53,351).—This company's annual return was filed on March 7th, when 12,000 shares were taken up out of a nominal capital of £100,000 in £5 shares. £60,000 has been paid.

Cambridge Electric Supply Company, Limited (36,457).—This company's annual return was filed on March 3rd, when 9,423 shares were taken up out of a nominal capital of £100,000 in £10 shares, £8 has been called up on each of 4,970, and £4 on each of 4,453. £57,572 has been paid.

by conductors leading to the transformers in the room

National Electric Supply Company, Limited (86,457).—This company's annual return was filed on March 9th, when 3,050 preference, 10,850 ordinary, and 100 founders' shares were taken up out of a nominal capital of £84,943 15s. in 9,050 preference shares of £5 each and 10,850 ordinary and 100 founders' shares of £3 12s. 6d. each; £5 has been called up on each of the preference and £3 12s. 6d. on each of the ordinary and founders' shares, and £54,943 15s. has been paid.

St. James's and Pall Mall Electric Light Company, Limited (26,015).—This company's annual return was filed on March 12th, when the entire capital of £300,000 in £5 shares (£20,000 preference) had been taken up and paid in full.

CITY NOTES.

Brush Electrical Engineering Company, Limited.

The eleventh ordinary general meeting of this company was held on Monday at the Cannon Street Hotel, Mr. J. B. Braithwaite, jun., presiding.

In moving the adoption of the report, the Chairman said they might congratulate themselves upon the gradual and steady progress which the company was making. That progress could, perhaps, be more easily seen on referring to the dividends which had been paid on the ordinary shares in recent years. In 1897 they paid 3 per cent.; in 1898, 4 per cent.; in 1899, 5 per cent.; and for that half-year they proposed to pay at the rate of 6 per cent. That, he thought, showed they were making progress in the right direction. With regard to the balance-sheet, the capital account remained the same so far as the ordinary and preference shares were concerned, and the debenture stocks were also the same, but in the half-year under review they had issued perpetual second debenture stock. £75,000 of this stock was over applied for and had been allotted. They offered the second debenture holders the opportunity of exchanging their second debentures for the new debenture stock, and the holders of £33,710 had exercised this option, and notice had been given to the holders of the remaining £16,290 that they would be paid off at £105 per cent. on July 1st next. There was little use in comparing the different items in the balance-sheet, because for the first time in their history it was a half-year's balance-sheet. The salient features of the balance-sheet was the creditors to whom they owed £49,344, as against £55,222. They therefore owed a little less. On the other hand, the debtors showed an increase, and they were owed £129,930, as against £123,380. They were therefore owed £6,000 more, and they therefore owed about £6,000 less, and the balance in their favour of those two items was about £12,000 better than at the end of June, which was an indication that their business was gradually and steadily improving. Their shares and debentures on the credit side stood at £70,953 16s. 3d., but the market valuation of those that were quoted was considerably in excess of that figure. The depreciation reserve fund stood at £15,000, instead of £10,000, as the result of the vote at the last meeting, and that day the board asked them to place a further £2,500 to that account. There were drawbacks to having a depreciation reserve fund invested in soft-edged securities, and there were advantages, and they tried to strike a happy medium between the two. The advantage was that when they wanted the money it was there, and could be got at, and it was not mixed up with the business. He would point out that it was distinctly a depreciation reserve fund, and if at any time there was a large outlay on renewals of plant, they would feel quite justified in going to such reserve. Hitherto that had not been necessary, and it might not be for some considerable time. The disadvantage of having the reserve fund invested outside the business was that it withdrew a considerable amount of capital from the business that would otherwise be useful as working capital, and therefore, if their company became as profitable as they hoped it would, they would not expect to see a corresponding large increase in the depreciation reserve fund outside the business. The gross profit on the trading, which included the profit from all sources, was £28,347 for the half-year, and although the accounts dealt with the bare half-year, it exceeded the half of the corresponding year by £1,360. On the debit side they would see they had spent large sums on the maintenance of buildings and plant, and that was equivalent to putting further money out of revenue to depreciation. They had spent at the rate of £5,200 for the whole year, as against an expenditure last year of £4,438, so that they had availed themselves of the increasing prosperity of the company to make a larger expenditure on the maintenance of buildings and plant. They carried forward a balance to profit and loss account of £19,410 for the half-year. The balance for the whole year ending June 30th, 1899, was £31,880, so that the past half-year showed an improved result of about £3,400. With regard to capital expenditure, he told them at the last meeting that owing to the rapid increase in their business, they were forced to continue capital expenditure on a somewhat considerable scale. During the half-year they spent £23,571 on further additions to their works at Loughborough, and they had further additions in progress, or under contract, amounting to another £53,000. They had acquired a further nine acres of freehold land, and had now something like 28 acres of freehold land, and if it became necessary to add to the large engineering shops, they would have the land in the right position to do so. To provide for the increased capital expenditure forced upon them, they proposed issuing a portion of the unissued ordinary and preference shares, and they proposed to issue a sufficient amount to provide for all the capital expenditure they would want for some considerable time, and also put additional working capital into the business, which they anticipated would be required by the increased turnover of the works. There was usually a difference between their debtors and creditors of £80,000 to £100,000, and that represented the capital necessary in the business, and as the business was increasing, that amount of capital would have to be also increased, and they therefore proposed to issue 30,000 preference and 30,000 ordinary shares, and offer them to the shareholders linked together. As, however, they did not wish to pay interest on the whole amount until it began to earn profits, they would make the shares, which were, as they knew, of £2, payable by four instalments. Their car shop was in full working order, and they were going to build another one of equal size. They had added very considerably to their heavy engine shop, and hoped to have it open by the end of June. The new inductor alternator which he mentioned they had great hopes of, had fully realised their expectations, and apparently had become one of the most popular generators in the country. They had also a large amount of work on hand in their car shops, for various Corporations in the country adopting electric traction were all wanting cars, not by dozens as used to be the case, but by hundreds. They had turned out some of the trains for the Central London Railway, which would be shortly opened. Their business was a very varied one, and, therefore, if one branch was slack they looked to be busy in others.

Mr. Sanderson seconded the motion for the adoption of the report, and it was agreed to.

Bournemouth and Poole Electricity Supply Company, Limited.

The annual meeting of this company was held at Winchester House on Monday last, Mr. A. H. Sanderson presiding.

In moving the adoption of the report, the Chairman said that the report dealt with the second year of the company's existence, but the first in which the accounts of the two companies had been amalgamated, the Bournemouth and District, and the Richmond Electric Light and Power Company having been purchased according to agreements. The balance of the authorised capital had been issued, the premium being carried to reserve. The speaker then went through the items appearing on both sides in the balance-sheet. Among these was £2,204 for depreciation, previously this was only £1,000, but they had added to it out of this year's revenue. A considerable sum had been expended during the year under the capital account in respect of mains, machinery, &c. The revenue account showed the progress made during the year, and enabled them to make a forecast of what might be reasonably expected in the future in the way of dividends. The gross receipts from the Bournemouth undertaking were £14,466, an increase of £2,542 on the year. On the other side, the profit balance was shown at £8,883, after deducting general charges, working expenses, and so on, which was a substantial increase on 1898's figure. This was increased by interest and dividends receivable from the Richmond Company, £2,483, less amount apportionable to capital £2,400. After deducting directors' fees for two years (£800), there remained a balance of £7,717, as compared with £6,013 for 1898. The balance of £7,717 was carried down, and including the balance brought forward from last year and deducting £1,500 for depreciation, and £693 for interest and special redemption, there was £6,799 to the credit of net revenue. The full dividend was paid on the preference and 5 per cent. was recommended for the ordinary shares, leaving £1,289 to carry forward. With reference to the progress of the business, the lamp connections were 44,096 8-c.p. at December 31st, an increase of 10,364 for the year, and applications representing 681 more were waiting connection. The increase was a record, and they had done even better than anticipated. The current sold during the year was 528,039 units against 414,662 for 1898, an increase of 113,377. Terms had been arranged for a supply of power to the Poole and District Electric Traction Company, and they looked to this to bring a considerable addition to revenue. It would provide them to a certain extent with a day load. The issue of £70,000 4½ per cent. debentures was over-subscribed. The increase in revenue had occurred notwithstanding the decreased charges to consumers. With reference to the Richmond undertaking, they had only lately purchased it; although they had made some reforms which would eventually turn out very satisfactory and increase the revenue, they had hardly had time to derive much benefit from the Richmond company, except so far as the small balance which had been transferred to revenue account. They had made a very satisfactory purchase, and they might look forward to success in the future.

The motion and one declaring dividend at 5 per cent. was carried, as were also resolutions re-electing Messrs. F. E. Savory and R. P. Sellon as directors, and the auditor.

Barcelona Tramways Company.

At the meeting of this company on Wednesday the report published in our last issue was adopted.

The Chairman, Mr. E. M. Underdown, Q.C., after going over some of the items contained therein, added that the board would probably later on submit a scheme for converting the Ensanche lines from mule to electrical working. Some of the directors were going to Spain to study that question on the spot. The electric traction installation was daily becoming more and more established, and it was gratifying to find that the receipts were also increasing in a satisfactory manner. For January and February of this year the receipts had exceeded by £4,522 (equal to 31 per cent.) those for the same period of 1899. It could not be expected that so large a growth in the traffic would

of England in its electrical developments. Other countries are far

£4 on each of 4,453. £257,572 has been paid.

continue indefinitely, but the quicker and better service that electric traction made possible was sure to have its effect. The diminution in working costs resulting from electric traction were enormous, although he did not feel prepared to give any specific figures until the system had been in full swing and it was known exactly on what basis to calculate the expenses. With increased receipts and reduced cost of working the outlook was favourable. With the new issue of capital they had money enough, they thought, for all likely purposes.

A resolution declaring 5 per cent. on the preference and 2 per cent. on the ordinary shares was carried. As to the question of selling the undertaking, it was stated that if an offer were made which would give the shareholders a satisfactory premium on their capital, it would have to be considered.

The County of London and Brush Provincial Electric Lighting Company, Limited.

The directors' report to be presented to the meeting to be held at Winchester House on Monday, March 26th, reads as follows:—"The directors beg to submit their report and statement of accounts for the year ended December 31st, 1899. Capital.—The capital expenditure during the year, on account of the company's London districts, amounted to £155,608 12s. 9d., making the total expenditure in respect of those districts up to December 31st last £718,195 18s. 11d., particulars of which are given in Capital Accounts Nos. 5, 7, 9, 11, 13 and 15. The expediture was met by the issue, in January, 1899, of £200,000 4½ per cent. debenture stock at a premium of £8 per cent. The premium received from the above-mentioned issue has been applied as follows:—

Reduction of general preliminary expenses		£10,000	0 0
Writing off costs in connection with applications for provisional orders		2,000	0 0
Amount placed to reserve for depreciation, repairs and renewals		4,000	0 0
		£16,000	0 0
Revenue.—Balance from last account after payment of the final dividend on the preference shares for the half-year ended December 31st, 1898, less income-tax		£5,775	18 6
Balance from revenue account No. II., after payment of directors' fees, rent, rates, taxes, general establishment charges, wages and proportion of salaries		45,417	8 6
Making a total available revenue of		£51,193	7 0
From which must be deducted the following items:—			
(a) Interest on debenture stock, including interest on instalments paid in advance	£5,032 11 0		
(b) Interim dividend on 20,000 6 per cent. preference shares for half-year ended June 30th, 1899, less income-tax	5,800 0 0		
(c) Amount placed to reserve for depreciation, repairs and renewals	6,500 0 0		
		17,332 11 0	
Leaving for further distribution		£33,860 16 0	

The directors recommend:—

(a) That payment of the interim dividend on the 20,000 6 per cent. preference shares for the half-year ended June 30th, 1899, less income-tax, be confirmed.
(b) That a further dividend on the 20,000 6 per cent. preference shares for the half-year ended December 31st, 1899, less income-tax, be declared; and
(c) That a dividend on the 40,000 ordinary shares for the year ended December 31st, 1899, at the rate of 4 per cent per annum, less income-tax, be declared, and that the same be paid to all proprietors registered at March 13th, 1900.

This will absorb £21,266 13s. 4d., and leave a balance of £12,594 2s. 8d. to be carried forward. The company's interest in the Richmond (Surrey) Electric Light and Power Company, Limited, has been disposed of to the Bournemouth and Poole Electricity Supply Company, Limited, at a profit. For the information of shareholders, a map showing the company's London areas of supply is attached hereto. The directors having accepted in November last Mr. A. J. Lawson's resignation as engineer and manager, have appointed Mr. Charles P. Sparks as chief engineer to the company. The retiring directors are Mr. J. B. Braithwaite, jun., and Mr. A. H. Sanderson, who are eligible for re-election. The auditor, Mr. R. H. Marsh, also retires, and is eligible for re-election."

London Stations.

St. Luke and Clerkenwell, Eastern Holborn and Western Holborn and St. Giles.—The balance to credit of revenue for the 12 months ended December 31st, 1899, amounted to £8,707 7s. 9d, details of which are given in revenue accounts Nos. 6, 8 and 10. In these districts, the total applications to December 31st last, including power, represented the equivalent of 80,923 8-c.p. lamps, of which 61,188 were then connected to the mains. The applications for the year represented an increase of 37,324, and the connections an increase of 24,886. At the same date 84 users of motors, aggregating 381 h.p. were supplied from the company's mains, showing an increase of 253 h.p. for the year, and further applications have since been received, raising the total to 125 users, representing 686 h.p. The special plant erected for the generation of continuous current for power purposes is capable of supplying 2,000 h.p. A supply of current in the Western Holborn and St. Giles district, was commenced in the summer of last year. The local authorities have not yet given their consent for the commencement of the compulsory works under the provisional orders held by the company for Mile End Old Town, St. George's-in-the-East, and the district of the Limehouse District Board of Works.

Wandsworth District (including the parishes of Putney, Wandsworth, Clapham, Streatham, and Tooting), *Camberwell and St. George-the Martyr, Southwark.*—The balance to credit of revenue, for the 12 months ended December 31st last amounted to £11,136 10s. details of which are given in revenue accounts, Nos. 12 and 14. In these districts the total applications to December 31st last represented the equivalent of 56,876 8 c.p. lamps, of which 54,647 were then connected to the mains. The applications for the year represented an increase of 24,240, and the connections an increase of 25,733. The work of laying mains throughout the compulsory area, and some additional streets in the Camberwell district, has been completed, and a supply of current was commenced in July of last year. A supply is also available in the district of St. George-the-Martyr, Southwark.

St. Olave.—Work is in hand for this district.

Investments in Provincial Electricity Supply Companies.

The Bournemouth and Poole Electricity Supply Company, Limited.—This company has made satisfactory progress during the past year. The directors have recommended the payment of a dividend on the ordinary shares of the company at the rate of 5 per cent. for the year ended December 31st, 1899, less income-tax, as compared with 4 per cent. for the previous year.

The Dover Electricity Supply Company, Limited.—This company has now reached a dividend earning stage. The balance from revenue account for the year ended December 31st last, after providing for interest charges and reserve for depreciation, has allowed the payment of a dividend on the share capital of the company at the rate of 3 per cent. per annum.

Imperial Tramways Company.

On Saturday last the ordinary general meeting of this company was held at Bristol.

The Chairman, Mr. George White, said that with regard to the London United Tramways, Limited, the accounts showed an increasing revenue for the undertaking. The preparations for the opening of the first section of about 10 miles of tramway route on this company's system were in an advanced state, and the shareholders had the satisfaction of knowing that they had a considerable interest in the first electric tramway to be worked in London. He should think that the opening of the tramway would be as nearly as possible coincident with the opening of the Central London Electric Railway, which terminated at the commencement of the new electric tramway, so that London's millions of population would have the advantage of through communication with a number of the western suburbs—an advantage which would be still further improved when the remainder of the authorised electric tramways were completed. Speaking of the opposition of the Middlesex County Council, he said their mission seemed to be to find out what the inhabitants of a particular locality wanted, and then to oppose those local aspirations tooth and nail. They had to go before Parliament, as directed by the Railway Commissioners, and had renewed their arrangements with the local authorities except Teddington, which wanted to screw out of the company further terms in addition to the splendid concessions already made to the district. The company were going to give Isleworth, Twickenham, Teddington, Hampton Wick, and Hampton the advantages of being connected with the main electrical tramway system, and all these districts were not going to be denied because one of the Councils was unable to make up its mind as to the point at which to stop turning the screw. He mentioned that although the London and South-Western Railway Company at first opposed, they were not going to offer opposition before Parliament. Agreements had been come to with the Ealing, Hanwell, and Acton Councils, and by filling up these gaps in their authorised system, they would secure a through line of electric tramways of about 12 miles in length on the main road from London to Oxford, commencing at the Central London terminus at Shepherd's Bush, and terminating in the town of Uxbridge. In all their system would comprise about 40 miles. He said the result of the year's trading was that they had a net profit of £30,251 on their investments in the various undertakings, and after allowing for interest on debenture stock and the interim dividends, they were able to recommend a dividend at the rate of 8½ per cent. on the ordinary shares. The reserve funds had been increased during the year from £47,824 to £69,203. The London United reserves had been increased to £36,190. He moved that the dividend mentioned be declared.

Mr. Hugh C. Godfray seconded the motion, which was carried.

Potteries Electric Traction Company.

Mr. Emile Garcke presided on Monday at Donington House, Norfolk Street, W.C., over the second ordinary general meeting of this company, and in moving the adoption of the report, said that was practically the first occasion on which the directors had had the honour of meeting the shareholders, because the statutory meeting was held within a few weeks of the allotment, and there was then little to report. Therefore that was the first occasion when they had to report any real progress, and he trusted the shareholders would appreciate that what had been done had been satisfactorily carried out. The Potteries Tramways consisted really of four separate tramway and light railway enterprises. First there was the North Staffordshire tramway system from Longton to Burslem through Stoke with a branch line to Boothem, about 6½ miles. Then there was the tramways undertaking promoted by other people, called the Potteries Extension Tramways, which extended the North Staffordshire tramways in various directions. There were also certain tramways within the borough of Longton, and, fourthly, the Light Railway Orders promoted by the British Electric Traction Company. The purpose of the Potteries

Electric Traction Company was to amalgamate all those various undertakings, which were at one time in separate hands and controlled by conflicting interests. There were no less than 18 local authorities affected by these various undertakings, and it would be no surprise to anybody, therefore, to know that the British Electric Traction Company had been engaged on this large enterprise ever since the beginning of the year 1895. He must take that opportunity of stating that great credit devolved upon Mr. S. Sellon, the engineer to the company, for the far-seeing manner in which the scheme was originally initiated. He hoped that the combined undertaking which had emerged from the weary negotiations which had been going on for the past five years would prove a great benefit and convenience to the very large population in the district, and he believed the shareholders who had provided the capital would be amply rewarded, not only by the knowledge that they were rendering a very great public service to the people in the district, but also in the form of satisfactory returns upon their investment. The point upon which the future success of that great undertaking rested was the rapid completion of the whole of the works. All other troubles had been overcome, and the only thing they had to work for now was the satisfactory completion of the engineering works. Those difficulties were troublesome, but they were difficulties of a kind they were accustomed to deal with, and which they took considerable pleasure in overcoming. Why they wanted the undertaking completed was that at present it was impossible to work sections with the highest economy and greatest efficiency, for the reason that the whole of the works and the whole of the organisation had been planned, not with a view of supplying 6½ miles or 12 miles, but the whole of the large system which was contemplated. The permanent way had practically been constructed and completed over the whole of the area, and until the electrical equipment was finished on those sections and the lines were working, they would recognise that a very large proportion of the capital which had been expended must remain unproductive. To show the inconvenience to which they were subjected, he might say that they designed their cars to run with the utmost economy, and had arranged for depôts to be constructed at the extreme northern and southern ends of the system, and at Newcastle, Chesterton and Silverdale. Until, however, these plans were complete, it was impossible for them to start trams in the early morning from those termini, and they were compelled to start all the cars from the present depôt at Stoke, and thus they had to run a very considerable amount of dead mileage in the course of a year. It was really a very serious item, and represented in round figures, in wages and loss of electrical energy, something like £1,000 a year. There were many other inconveniences which were inseparable from the working of only a part of a large system. They would bear in mind that the whole of the engineering staff and the offices for the purposes of administration had been appointed with a view of running not a small system, but a very extensive system, and therefore the standing charges of the undertaking were out of proportion to its earning capacity. Therefore it was of the utmost importance that they should complete the whole of the undertaking as soon as possible, because as each additional section became revenue—earning it became so out of proportion to the additional mileage. A very important point bearing upon this matter was the purchase price which the company had paid to the North Staffordshire Tramways Company for their interests in the company. The expenditure on the North Staffordshire Tramways Co. represented something like £220,000, which worked out at something like £34,000 a mile. But the whole capital of the undertaking would be under £600,000. As the company would have over 30 miles of line, the average of the whole undertaking would be less than £20,000 a mile, so that at present they had to earn dividends on a large proportion of capital which was not relatively as productive as it would become later on. The directors there had made the greatest effort in their power to complete the works as quickly as possible, and although the subscribed capital had not been quite sufficient to meet the expenditure, they had made temporary arrangements in regard to providing the additional money which they required. They had opened now about 20 miles of tramway, and the conversion of the North Staffordshire trams from steam to electric traction had been carried out without any interference with the traffic. On May 16th the steam cars were sent out in the morning, and by 12 o'clock noon they were all replaced by electric cars without the slightest interference with the traffic. Since the conversion of the North Staffordshire tramways to electric traction there had been a large increase in the passenger receipts, and as additional feeders to the line were opened, it was anticipated that the increase would be far larger than it had been. To put the result of the year's working in a few words, he might say they had earned a dividend on half the capital which had been employed, although they had worked less than one-third of the total system, and had worked that under very disadvantageous circumstances. He thought the results of the working, so far, could be taken as a favourable augury for the future. He might add that they had carried 5½ millions of passengers, so that the shareholders would readily perceive the great public service the company would be performing when the scheme was completed. They had now 48 cars running, and when those on order were delivered they would have 88 cars in regular operation. In conclusion, the chairman referred to the financial position of the company, and said that the capital actually issued was £400,000. In the prospectus it was stated that they would have to spend something like £540,000 to complete the works, and the board proposed to raise the additional capital required by the issue of debenture stock.

Mr. S. Mear seconded the motion.

Replying to questions, the Chairman said they were on good terms with the local authorities. They might without being too sanguine expect to complete all the works with the year. A line between Newcastle and Stoke had been contemplated, but they were bound to proceed cautiously.

The motion was then carried.

Brompton and Kensington Electricity Supply Company.

The twelfth ordinary general meeting of the above company was held on Thursday last week at Winchester House, Mr. Henry R. Beeton (chairman) presiding.

The Chairman said: In moving the adoption of the report and accounts, there are one or two observations which, with your permission, I should like to make. The revenue account for the year, beyond showing more satisfactory progress than previously, does not call for any special notice. I may, however point out that there is a slight reduction in "works" costs and "total" costs, notwithstanding the enhanced price of fuel. I may mention also in passing, that both the number of lamps and the consumption of current have been larger than in any previous year, notwithstanding that the rate of increase in the number of customers was not so large as in 1898—a circumstance which testifies, in common with the experience of other companies, that the appetite for electric light is growing. Turning to the capital account, you will notice that the expenditure for the year under review has been the largest in any year except the first of the company's history. You will also notice that a large expenditure has been incurred in renewing machinery and mains rendered obsolete by the wear and tear and the progress of invention. The policy of adopting up-to-date plant, which has been foreshadowed in our reports and at our meetings for the past two years, may be said to have culminated in 1899, at the close of which year plant representing an original cost of £25,000 had been removed, £7,000 on account of exhaustion, and £18,000 on account of antiquation, and when further plant representing a cost of £6,000 has been similarly dealt with this year, it may be said that the renovation of our station will be practically complete. In order to provide the net cost of this plant, the directors propose, after calling upon the revenue account for £4,500 as a current contribution for wear and tear, to appropriate £2,500 out of profits, and £7,000 from depreciation account, leaving a balance of £14,202 to be dealt with in the future, when the profits will, of course, benefit from the operation. When the rate of increase in our net revenue is compared with the progress of our capital expenditure, it will be manifest that it will not be long before the balance of the amount remaining to be dealt with will be disposed of, and that shareholders may reasonably anticipate an enhanced dividend in the near future. It is perhaps hardly necessary to refer to the fact, alluded to in our report, of the abandonment of the original title of the company in favour of one which more correctly conveys its nature and objects, and which was at the same time associated with our area of supply. Another point you will notice in the report is that we have abolished the office of managing director, which office has been discharged for many years by Mr. Page, to the great relief of the directors. The fact is that our buildings are now complete. The buildings are completed, and the plant so standardised, that the directors feel it does not call for quite the same measure of supervision on their part as it did, and we have made other arrangements. Of course, we shall still keep in touch with the works, and perhaps the rest of the board will see more of the works than they had done in the past.

Mr. Lebus seconded the motion, and it was agreed to.

A final dividend at the rate of 7 per cent. on the ordinary shares was agreed to, making, with the interim dividend, 6 per cent. for the year.

Mr. W. R. Davies moved the re-election of Messrs. Beeton and Page, as directors, and this was seconded by Mr. Schaeb, and carried.

Mr. Pierce proposed a hearty vote of thanks to the chairman, directors, and staff, and this was seconded by Mr. Fitch, and agreed to.

The London Electric Supply Corporation, Limited.

The report of directors to be submitted to the annual meeting at Cannon Street Hotel on Wednesday, March 28th, at noon, reads:—

"The directors submit their report and statement of accounts for the year ending December 31st, 1899. The number of lights at December 31st was 173,906, an increase of 18,587 for the year. The directors are of opinion that this increase would have been more than doubled, but owing to the default of the contractors in delivering the additional plant ordered in 1898, to meet the requirements of last winter, some of which has not yet been completed, they were only able to accept a very few orders during the last six months. The strain thrown upon the existing plant through this default, the great increase in the price, and the difficulty in obtaining an adequate supply, of Welsh coal, have all tended to increase the cost of generation, and to temporarily impair the efficiency of the service. A new 900-H.P. plant has been added during the year. New trunk mains amounting to 3,889 yards, and new distributing mains to 18,362 yards have been laid, the total length of mains now laid being over 100 miles. The lease of the offices and distributing station in Cockspur Street was purchased on advantageous terms. The plant and machinery have been entirely maintained out of revenue. Additional capital being required for the further development and extension of the company's works, the shareholders will be asked, at the ensuing meeting, to pass a resolution authorising the directors to raise such capital as they may, from time to time, deem desirable in the interests of the company. The profit on the working for the year is £21,547 16s. 6d., to which has to be added interest on deposit £589 0s. 6d., and the amount brought forward from last year, £3,275 9s. 7d., making a total of £25,412 6s. 7d. Out of this the interest on the debentures to December 31st, viz., £8,000, and an interim dividend at the rate of 6 per cent. per annum on the preference shares to June 30th, 1899, amounting to £7,476, has been paid,

leaving £9,936 6s. 7d. now to be dealt with. The board propose to deal with this amount as follows:—

By payment of a dividend at the rate of 6 per cent. per annum on the preference shares for the half-year ending December 31st, 1899	£7,476	0	0
Provision for special rebates	1,000	0	0
And to carry forward	1,460	6	7
	£9,936	6	7

The directors regret that their colleague, Mr. Roger de Q. Quincey, resigned his seat on the board during the year on account of age, and, in accordance with Article 76 of the articles of association, they have elected Sir W. H. Preece, K.C.B., F.R.S., to fill the vacancy. The retiring director is the Right Hon. the Earl of Crawford, K.T., F.R.S., who is eligible for re-election. The dividend warrants will be sent out on 31st inst. A form of proxy is enclosed herewith, which any shareholder unable to attend the annual meeting is invited to sign and return to the secretary two days before the date of the meeting."

Ernest F. Moy, Limited.

The directors' report to be submitted to the meeting at 2, Greenland Place, Camden Town, N.W., on Monday, March 26th, says that the balance-sheet and profit and loss account for the 12 months ended December 30th, 1899, show a profit of £655 1s. 2d. for the year. This is to be dealt with as follows:—10 per cent. dividend on 5,391 ordinary shares; 6 per cent. dividend on 1,071 preference shares, less income-tax; 10 per cent. of profit to general reserve account; income-tax on profit, £655 1s. 2d.; redemption of three £10 debentures; balance carried forward, £55 14s. 2d. = £655 1s. 2d. The directors again propose to carry 10 per cent. of the profit to the general reserve account, which, with the premium received on the ordinary shares issued during the year, will bring up the reserve to £428 16s. 9d., and by carrying forward the balance of last year's profit, viz., £55 14s. 2d., to commence this year with £300 11s. 4d. in hand. A new reserve account against bad debts has been opened with an amount of £290 16s. 8d., which has been recovered during the year, and which had previously been written off as bad. The directors have secured the adjoining premises, No. 4, Greenland Place, on a 21 years' lease, and the two buildings, Nos. 3 and 4, now communicate, and are well fitted up with high-class machinery. Mr. P. H. Bastie, director, offers himself for re-election.

The Direct Spanish Telegraph Company, Limited.

The directors' report for the year ended December 31st, 1899, to be presented at the general meeting on Tuesday, March 27th, reads as follows:—

The annexed accounts for the year ended December, 1899, show, after providing for interest on, and redemption of, debentures, a balance to the credit of revenue of £9,825 4s. 8d. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £4,325 4s. 8d., which, together with £1,160 19s. 4d. from the contingencies account, enables the directors to recommend the declaration of the dividend of 10 per cent. on the preference shares, and a dividend of 4 per cent., free of income-tax, on the ordinary shares, for the year 1899, amounting to £5,486 4s. Half of this amount was distributed on October 1st, 1899, as an interim dividend in respect of the half-year ended June 30th, 1899. The traffic receipts show a decrease of £6,352 9s. 8d., as compared with the year 1898 when they were exceptionally large owing to the Spanish-American war. The ordinary working expenses are £595 7s. 1d. in excess of those for the year 1898. On October 11th, 1899, the Falmouth-Bilbao cable broke at a distance of about 200 knots from the English landing. It was promptly repaired by a cable ship of the Eastern Telegraph Company on October 18th, 1899. The cost of these repairs, viz., £1,743 7s. 4d., has been taken from the reserve fund. The Marquis of Tweeddale, K.T., is the director retiring by rotation, and offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and offer themselves for re-election.

The South London Electric Supply Corporation.

The ordinary general meeting of the shareholders of this company was held on Thursday last week at Winchester House, Old Broad Street, Mr. George Ellis, J.P., presiding.

The Chairman, in moving the adoption of the report, said the shareholders would be pleased to hear that the generating station and works were practically completed on November 28th last, so that they were able to energise in their entirety the whole network of mains from their own machinery. It would be a matter of interest to them to know that with the exception of the delay in acquiring the land at the outset, the central station had been erected and machinery placed in position and put to work within six months of the time originally estimated; a result most satisfactory, having regard to the magnitude of the work and to the congested state of the engineering trade in this country. Some idea of the size of the undertaking might be realised when he told them that it had been designed and was now ready to supply electric current over a district approaching 4,000 acres, and they thought it matter of congratulation that they had been able to get work within such a short period of their original forecast. Up to date they had not been able to use the dust destructor for the purpose of raising steam, although they had for some weeks past been burning about 50 tons of ash-bin refuse per day. The reason for that was that the contractors had not been satisfied that the massive firebrick furnaces were sufficiently dry for it to be safe to raise the temperature to the high degree necessary for producing steam. That prohibition had, he believed, been withdrawn that day, and he, therefore, trusted that the consumption of coal would be largely reduced, and that they would obtain all the hoped-for advantages from the destruction of refuse. They were arranging with the Lambeth Vestry to supply them on and after March 25th with 100 tons daily at the agreed upon price of 11½d. per ton. The generating machinery consisted of four steam alternators capable of developing, at this moment, over 2,800 H.P., while the fifth machine, in course of construction, would give a further output of 1,400 H.P., making a total of 4,200 H.P.—ample for any requirements they might have for some time to come. The mains consisted of a network extending pretty well over the whole area of supply, and one of the most hopeful features of their business was that they were obtaining consumers from all parts of the parish, and not from one or two wealthy centres only. Although at this period many shareholders might consider the revenue very small in comparison with the capital outlay, it must be remembered that the company was formed to erect as speedily as possible an electric light station for Lambeth, and to equip it right away with machinery and plant powerful enough to develop energy for the requirements of the vast area he had alluded to. These were the conditions under which the company was formed; it was not contemplated to erect a station piecemeal and lay down machinery as required. The experience of those companies who had so proceeded had been that they had always found themselves in great difficulties as their business expanded, owing to want of plant and insufficient room in which to erect more. The conditions of their existence safeguarded them against that great mistake, for, as he had said before, they had adequate plant to meet all requirements, so far as they could be seen, for some years. He ventured to say that no other station in this kingdom had succeeded in obtaining such a load, viz., over 25,000 lamps previous to the date of its first running it's own machinery. Having referred to the dates at which other companies commenced the payment of dividend after their establishment, he said it must be remembered that they were in a neighbourhood where gas was sold at a remarkably low price. Every possible effort was being made to obtain business, and he was pleased to say steady progress was being made. They hoped soon to be able to reduce the price from 6d., provided the provisional order for that portion of the parish outside their order was obtained. That additional area would enable them to increase their output so as to justify them in reducing their charges.

Mr. J. T. Atherton seconded the motion, and the report was adopted.

On the re-election of the retiring directors coming forward, Capt. Ironside Bax was re-elected, but when Mr. Bennett Fitch, the other retiring director, was proposed, Mr. Atherton nominated Mr. F. G. Leslie, of Liverpool, in his stead. He explained that he did not oppose the re-election of Mr. Fitch on parsonal grounds, but as a large shareholder in the company he thought they wanted new blood on the board, so that a more spirited policy might be pursued.

Mr. Pearson seconded Mr. Leslie's nomination.

On a show of hands Mr. Fitch was elected by 20 votes against 15 for Mr. Leslie, whereupon Mr. Atherton demanded a poll on behalf of the latter gentleman. This was at once taken, with the result that Mr. Fitch received 11,034 votes, and Mr. Leslie 22,874 votes, Mr. Leslie, therefore, being elected. Mr. Atherton was also elected to the board, receiving 23,924 in favour and only 130 against.

Davis & Timmins, Limited.

Sir Henry C. Mance presided on Wednesday last week at Winchester House over the second general meeting of the shareholders of the above company, and, in moving the adoption of the report, said they would all agree that it was eminently satisfactory. If anyone placed the accounts side by side with the prospectus which was issued to the public in February of last year, he thought he would come to the conclusion that Mr. Emile Davis and his co-managers had more than justified the statements made and the hopes held out to the public. That must be especially satisfactory to Mr. Davis, because, from his (the chairman's) brief acquaintance with the company, he knew full well the anxiety he felt to show the public that they were justified in putting their money into the venture. The report was very brief, and required very little comment from him. After allowing £1,043 for depreciation of plant, machinery, premises, &c., they had made a net profit for the year of £9,400 17s. 4d. They were obliged to place to the credit of capital any profits made previous to the issue of the prospectus, and the accountants had decided that £2,240 15s. 1d. was a fair amount to be apportioned as profit made previous to the formation of the present company, and therefore not available for dividend. On the other hand, certain expenses—interest to vendors from January 1st, stamp duties attendant on the formation of the company—amounting altogether to £786 14s. 1d., had been written off against that preliminary profit, and the balance of £1,454 1s. had been placed to capital account, and practically that would form the foundation of a reserve fund. That left them with a balance of £7,160 2s. 3d. to dispose of. They had already paid the preference shareholders their dividend up to the end of June last, and had £6,387 1s. 8d. remaining, which the directors proposed to employ as follows:—The preference shareholders would receive their interest up to December 31st, and they proposed to pay a dividend at the rate of 8 per cent. per annum on the ordinary shares for the period during which the company had been in operation. They proposed further to carry forward £1,520 to next account. Of course, they would understand that they could have placed the greater portion of that amount to a reserve fund, but they were opening a new factory, and extending their business, and they thought it better that they should keep as much money as possible immediately available as working capital. As to the balance-sheet they would see that at the end of the year there were some unpaid calls. They did not want the money, and did not press particularly for it, but he might tell them that all the calls had since been paid. The bills payable were mostly on account of metal. The bills payable to

bound to proceed cautiously.

The motion was then carried.

interim dividend at the rate of 6 per cent. per annum on the preference shares to June 30th, 1899, amounting to £7,476, has been paid,

sundry creditors, which included many miscellaneous expenses, were about balanced by the sundry debtors on the other side of the account. The amount brought from the profit and loss account was £94,000. £75,130 8s. 6d. stood against premises, goodwill, patents, &c., but that had been reduced by the £1,454 1s., which he had already referred to. The stock, £5,867, mostly consisted of metal, although, of course, they were obliged to keep a certain amount of manufactured stock. He might mention that the materials were mostly metal rods, the value of which had been taken below cost, and much under the present market value. The cash item of £22,143 16s. 3d. was a large and very satisfactory one. It consisted of profit made during the past year, and the money remaining unexpended would be required to complete the payments for their new factory and machinery. Passing to profit and loss account, he might explain that the first two items included all the miscellaneous expenditure of the company, as, for instance, advertising, office expenses, postage, carriage, travelling, insurance, fuel and gas, the latter being a very heavy item on account of their gas engines. They had allowed 7½ per cent. depreciation on the plant, and that they would agree was quite sufficient, considering that it was modern and quite up-to-date plant, and that they employed a special staff simply for the purpose of keeping the plant in thoroughly efficient order. They had completed and despatched to Paris for the Exhibition a very handsome case filled with the manufactures of the company very artistically arranged. They had secured a good position for it, and trusted that the show would add to the reputation of the company. The shareholders would no doubt be anxious to know how they were getting on with their new factory. There had been a great difficulty in getting deliveries of iron and steel goods during the year, and a delay in the delivery of the girders required for the roof, and the weather had been somewhat against them, but notwithstanding those drawbacks he thought they had made very fair progress, the building now being covered in completely. For the equipment of the new factory they had made arrangements for the supply of the most important machinery and the delivery of that had already commenced, and as soon as the building was handed over to them by the architect the erection of the machinery would be proceeded with. If all went well they might reasonably hope to have the factory in full swing by the autumn, and perhaps sooner. Their freehold land at Wood Green was about 1¾ acres in extent, and had now been enclosed. The building had been designed with a view to further extension. The present building was 166 feet by 90 feet, lighted by five bays giving a northern light. The engine house was apart from the main building, and was 35 feet by 45 feet. They had still sufficient ground available to enable them at any future time to double or treble their working capacity. Their engine indicated 100 H.P., and room had been left in the engine house for duplicating the motive power if necessary. All the machinery would be driven by electric motors. The engine would be supplied by gas made on the premises. They had found it rather difficult during the year to execute the whole of their orders through the congestion of the traffic on the railways and also the congestion of the iron and steel trades, and they had had so many orders that he had no doubt when the factory was opened they would have no difficulty in finding work for it. They had added upwards of 100 customers to their already extensive list during the past nine months. Last year's working was, he understood, the best on record, and the present year had put a certain amount of work in their way. They tried to broaden their basis as much as possible, so as not to depend on any one industry. They had every reason to anticipate a prosperous career for the company.

Mr. E. Davis seconded the motion, and it was agreed to.

The City of London Electric Lighting Company, Limited.

An abstract of the directors' report appeared in our issue of March 9th; we now give it in full:—

Your directors beg to submit their report and a statement of accounts for the year ended December 31st, 1899, as certified by the auditors.

Capital.—The expenditure on capital account during the year ended December 31st, 1899, amounted to £138,766 18s. 4d. Details of this outlay are given in the capital account No. III.

Revenue.—The total revenue for the year was £187,253 1

from which must be deducted the following items:—

Expenses of generation and distribution	£69,478 15 11	
Rent, rates, taxes, general and special charges	90,451 2 6	
Transfer to depreciation fund No. 1	21,000 0 0	
Transfer to reserve fund	2,349 10 7	
		£123,279 9 0
Leaving		63,974 7 7
To which must be added the balance brought forward from 1898		3,3-1 13 6
Making a total available revenue of		£67,354 1 1
Of this sum the following amounts have been distributed:—		
(a) Interest on debenture stock for year ended December 31st, 1899	£19,333 6 8	
(b) Interim dividend on £400,000 6 per cent. preference shares, paid in July last on account of the distribution for the year	11,600 0 0	
		30,933 6
Leaving for further distribution		£36,422 14 5

Your directors now recommend that the following dividends for the year ended December 31st, 1899, be declared, subject to the deduction of income-tax, to members registered in the books of the company on March 1st, 1900.

Preference shares Nos. 1 to 40,000.—12s. per share, being a distribution for the year at the full rate of 6 per cent. Of this sum 6s. per share was paid on account in July last, and it is proposed that the balance of 6s. per share be paid on March 16th, 1900.

Ordinary shares, Nos. 40,001 to 100,000.—8s. per share, being a distribution at the rate of 4 per cent. for the year. It is proposed that this dividend be paid on March 16th, 1900.

This will absorb £34,800 and leave a balance of £1,622 14s. 5d. to be carried forward. It is proposed that the warrants for the respective dividends shall be posted on March 16th, 1900. The generation and distribution expenses for the year, including repairs and renewals, were 49·31 per cent. of the gross earnings, as compared with 36·1 per cent. for 1898, 31·3 per cent. for 1897, 34 per cent. for 1896, 36·87 for 1895, 46 for 1894, and 54·2 for 1893. The increase in the percentage during the past year is due to a largely increased output having been supplied at a greatly reduced rate of charge to the consumer. The following comparative statements show the position of the company as it was in 1892 and at subsequent periods.

Number of Customers and Lamps Connected.

	Dec. 31st, 1892.	Dec. 31st, 1893.	Dec. 31st, 1894.	Dec. 31st, 1895.	Dec. 31st, 1896.	Dec. 31st, 1897.	Dec. 31st, 1898.	Dec. 31st, 1899.
Number of customers being supplied	242	1,050	2,740	4,230	5,303	6,322	7,414	8,738
Number (equivalent) of 8-c.p. lamps connected	20,241	65,341	135,460	195,317	247,785	296,012	355,825	429,628

On February 21st, 1900, there were 465,712 8-c.p. lamps (equivalent) applied for, out of which 444,361 were connected. The B.O.T. units sold for private lighting for the year 1899 were 7,446,703, as compared with 5,837,317 for 1898.

Statement of Income as shown in the Audited Statements of Accounts Issued by the Company.

	For the period to Dec. 31, 1892.	For the year ended Dec. 31, 1893.	For the year ended Dec. 31, 1894.	For the year ended Dec. 31, 1895.	For the year ended Dec. 31, 1896.	For the year ended Dec. 31, 1897.	For the year ended Dec. 31, 1898.	For the year ended Dec. 31, 1899.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Gross revenue (after deducting allowances to consumers)	12,450 5 4	39,662 17 9	69,863 19 3	106,999 17 2	146,946 14 7	175,792 18 2	175,607 15 8	187,353 16 7
Net revenue available for depreciation, reserve fund, interest on debenture stock and dividends	500 (est.)	16,940 14 10	34,865 2 6	59,100 5 11	85,701 8 3	107,550 2 4	97,842 1 6	87,823 18 2

Depreciation and Reserve Funds.—The statutory provision for these funds, in accordance with the City of London Electric Lighting Act, 1893, has been made, of which £23,349 10s. 7d. have been set aside out of revenue. The directors are promoting a Bill in Parliament for the compulsory acquisition of certain properties, which interfere with the full development of the site of the Bankside Station, and for relieving the company of the statutory obligations, as to the provision of depreciation and reserve funds, imposing in lieu thereof, no larger obligations than are imposed on other companies who have to keep their accounts in the form required by Board of Trade, and for various other necessary matters.

Additional Capital.—Your directors have resolved to issue 20,000 ordinary shares of £10 each, being the balance of the additional £400,000 ordinary share capital created by a resolution passed at the general meeting of the company held on February 24th, 1897. This issue of 20,000 ordinary shares will rank for dividend as from January 1st, 1900, *pari passu* with the existing ordinary shares, and will be allotted at par *pro rata* to the holders of preference and ordinary shares, who were registered in the books of the company on March 2nd, 1900, or to their nominees.

Continuous Current and Alteration of Standard Pressure.—The approval of the Board of Trade has been received to the company's system of continuous current and to the alteration of standard pressure. The additional buildings and plant are rapidly approaching completion, and the alteration of consumers' fittings to adapt them to the higher pressure is being actively proceeded with.

Your directors regret that this company's opposition to the applications has been unsuccessful. The expenditure in connection therewith, amounting to £3,645 19s. 9d., the balance of suspense account, £4,260 14s. 3d., and replacements, &c., £3,647 14s. 3d., have been written off out of the balance of premiums. In accordance

arranging with the Lambeth Vestry to supply them on and after March 25th with 100 tons daily at the agreed upon price of 11½d. per

bills payable were mostly on account of metal. The bills payable to

with the articles of association, two of their number, Sir David Lionel Salomons, Bart., and Mr. Philip Debell Tuckett now retire, and being eligible, offer themselves for re-election. Messrs. W. H. Pannell & Co. the auditors, retire, and being eligible, offer themselves for re-election.

Sir David Salomons (chairman) presided on Thursday last week over the ordinary general meeting of the above company, held at Winchester House, and, in moving the adoption of the report, said that 12 months brought about great changes, and the position of the company that day compared with what it was last year was this—that they were then threatened with competition, and to-day it was an accomplished fact, for although active competition had not commenced, the powers had been granted. That had been mainly due to the course taken by the Corporation of the City of London. It was not his intention to weary them with the history of the company, nor with the application of the Charing Cross Company to supply current within the City limits, or with the Board of Trade inquiry which followed, or the passage of the Bill through Parliament, for not only were those facts known to them, but the board had sent round a circular to every shareholder giving details, and, as they knew, the directors had at every step stedfastly opposed, and they thought righteously opposed, any attempt on the part of a competing company to come within the City area, and they had done that entirely in the interests of the shareholders. They had failed, but they trusted that their case having been shown, that some good at all events would come, and that the public in the end would come over to their side. The directors also made an offer to sell the Corporation their undertaking, but it was declined, so that they felt that everything had been done on their part to protect and guard their interests. That the Corporation had broken their pledges when the contracts were made no man in his senses could possibly doubt, and if any further proof of that was required, it was that they were defending an action in the High Court where they had asked that the contracts should be declared valid. The fact that the Corporation relied on was that certain members of Corporation held shares in a certain company or companies, but they, as the City of London Electric Lighting Company, clearly could not prevent any members of the public or the Corporation holding any particular shares. The contention of the Corporation was so unfair, that they might borrow money from the Bank of England, and refuse to refund the money on the ground that a member of the Corporation held bank stock. In fact, if the Courts eventually upheld the view that the Corporation was right and that the contracts were void, further legislation would become necessary to enable municipal business to be possible. There had been another action between them and the Corporation—of a friendly character, so to speak—to interpret certain words in the contracts on which there were doubts. The Courts had decided the most contentious points in the company's favour, and the Corporation had lodged an appeal, which would not be heard until after the question of the validity of the contracts had been decided, and it was to be hoped that would come on very shortly. He had always told them that the policy of the board had been to reduce the price of electric energy to customers as quickly as they could afford to do so, but under the circumstances of threatened competition they had no alternative but to reduce the price to that on a par with, or below even, that of the competing company. This policy was forced upon the board, and now electric energy was supplied cheaper in the City of London than in any other part of the metropolis. Certain difficulties had arisen from that course. They had a decreased revenue and the same amount of work done, while they had also an enormous demand. Making a comparison between the period of 1899, when the price was lowered, and the corresponding period, the additional increase in applications worked out at 12,000 lamps, and that increase continued. This put a tremendous strain not only on the engineers' staff but also on the generating station, and at a most inconvenient time when coal was only to be obtained with great difficulty and expense. Indeed, they had been forced to use very inferior coal, which had given them enormous trouble, and it was the reason why on some occasions there had been low pressure at the customers' lamps. But if they read the papers they would see that these troubles and difficulties were in no way confined to that company, and in some places they had extended to the gas companies. Every effort was being made by the board as well as the technical staff to prevent such occurrences in the future. They would see also that the percentage of generation and distribution expenses to gross earnings considerably exceeded that of the previous year, but that they would clearly understand must be the case from the remarks he had made, but in the year they were now passing through those figures ought to be greatly modified in their favour, because unless any unforeseen misfortune pursued them the coal trouble would be less; they would have a much larger output, and the standard charges would remain practically what they were last year. Consequently, in the ordinary course of things their gross return should be considerably larger, and the net return should also advance in the same way. Every year the board had made provision in advance for 60,000 lamps to meet the coming winter load. Machinery could not be put in in a day, and they could not get deliveries without ordering considerably in advance, and they had, therefore, thought it advisable to look one year ahead in all their proceedings for the central station. But the contractors had almost invariably failed to deliver to time, and in many instances they had been 18 months or more behind. If the increase, owing to the decrease in the price per unit, went on, as it appeared likely to do, they would have to order from 75,000 to 100,000 lamps in advance one year in order to be sure that they could supply without any pressure when the proper time arrived. The equivalent number of 8-c.p. lamps connected by the company was 468,831, and the number awaiting connection 22,000. The capital expenditure had exceeded the capital subscribed by £113,456 0s. 10d., and this was absolutely necessary, for it would never have done for the demand to have exceeded the supply. The directors had decided, therefore, to issue the remaining authorised shares—some 20,000 in number—*pro rata* in accordance with their holdings, to the preference and ordinary shareholders at par. The accounts had been treated as in previous years. Part of the depreciation had been taken out of the premium fund. They laboured under one disadvantage, as Parliament had imposed upon them the necessity of keeping their reserve fund in securities outside the business of the company, a condition which, he believed, did not exist in any other company. It would be a very big advantage to be able to make use of their reserve fund in their own business, and that was what their Bill now sought to bring about. They considered themselves justified in declaring a dividend of 4 per cent., but as he had already pointed out, over-spent capital would be replaced out of that issue of shares. Last year the premium fund was debited with £27,307, and this year with £19,718 8s. 2d. He might point out that that year they had had exceptional expense in connection with the Charing Cross order, which they had decided to wipe out of suspense account, and they also supplied during the best portion of the year at a much less figure than before, while the question of coal had made a difference to their profits. Turning to the accounts, the chairman pointed out that Nos. I. and II. accounts—statements of share and loan capital—were the same. In No. III. capital account there was a large increase in mains due to increased demands. Wiring, motors, &c., was £2,000 more, which showed that the public was taking advantage of the policy the board had adopted. The increase in meters and electrical instruments was due to the increasing number of customers. The item of £37,313, warehouses and other works at Wool Quay, would earn at the rate of 5 per cent. by way of rent from the shipping firm who were in possession, and it also would relieve them of a ground rent of £4,000 a year. With regard to the revenue account, he had explained the increase in the cost of coal. They would no doubt hold the opinion that they had passed through a very stormy time, and it might be a long way ahead before they had calm. It was only right therefore that they should know what was likely to happen in the future. Their chief engineer, Mr. Bailey, had made an exhaustive report to the board, showing that when all their machinery on order had been erected they would be able to connect 824,500 odd lamps on their mains. They would draw a distinction between supply and connect, because they did not supply them all at once. Consequently, they would be able to connect many thousand more lamps, and if the demand went on increasing it would not matter, because it did not signify how much their capital increased so long as they were able to earn a proper return upon it. The competing company would start at an enormous disadvantage, and must have a capital far larger than theirs to give the same output. They purchased the greater part of their central station site at an exceedingly moderate figure, and their machinery and metals were purchased when they were much cheaper than at present. Copper for a very large portion of their mains was purchased at a time when copper was only £40 a ton, and now it was approximately £80 a ton, and their iron pipes cost from 20 to 25 per cent. below the price at the present time. Their station was close to their works, and, therefore, the distribution losses were not unreasonable. The Charing Cross Company little realised the difficulties it would have to contend with, and the directors believe that the attempt of that company to compete successfully with them was foredoomed to failure. Some of their directors had said that the Charing Cross Company would have a very great point in their favour, as they would be able to have the most efficient and modern machinery, whilst that of the City Company was out of date. Such an argument he entirely traversed, because their machinery was neither antiquated nor out of date. Indeed, every day such types were being erected in various parts of England and abroad, showing that it was a system which would pay. But the City Company did not give only one type of current, for they had the alternating and continuous systems. With regard to price, the last six months' working had shown that an all-round maximum 4½d. rate for lighting purposes did not pay, and the board had considered the best method of dealing with that, so that the earning power of the company might become more profitable. Their customers might be divided into two classes—those who used their lamps for a very short period and those who used them for a long period. They had come to the conclusion to adopt a scale of charges by which the price per Board of Trade unit became reduced according to the time that the lamp was in use, and this would encourage the long-hour consumer.

Mr. Geo. Herring, in seconding the motion, said that while their position was bad, there was no reason to despair. They now commanded the greatest city in the world, as regarded its lighting, and his reason for saying they commanded it was this: The chairman had gone into figures, and he thought they might take it for granted that their site in the City was bought cheaper than the site of the Charing Cross Company would be bought outside the City. The Charing Cross Company proposed to promote another company, with a capital of £800,000, but that was a ridiculous amount of money, because the work could not be done for that. Their site would cost more, and copper and machinery had risen in price, and although the City of London Company might have made mistakes, yet he thought it was impossible that the Charing Cross Company could do the work for much less than a million and a half of money. He asked them if there was any chance of their getting that amount of money to compete with the City of London Company on ground they already fully covered. As regards price, the City Company could compete with them, and the only possible chance the Charing Cross Company had was to say they could give a better light. His answer would be, that they would be liable to the same difficulties that that company was. They would find just the same difficulties with plant and coal, and he would

auditors.

been written off out of the balance of premiums. In accordance

safely prophesy that before the Charing Cross were able to compete with them the City Company would be able to say they could supply a light which would be unfailing. If they thought the board had not carried out their duties properly they could be replaced, and he personally would be glad to be relieved of the worry; but if, on the other hand, they considered that the directors had done the best for the company, they must supply them with more money to keep pace with the growing demands. Many great industrial concerns passed through times of adversity and pulled through, and he felt certain that that would be their case.

Some discussion followed, the various speakers sympathising with the directors in the difficulties they had had to contend with.

In reply, the CHAIRMAN said the board fully realised that there was competition, and also that should the Charing Cross Company not come in, another company might. The interim dividend was not paid, because it was not earned, and it was impossible for the board to know what the new scale would be.

The report was then adoped.

On the motion of the CHAIRMAN, seconded by Mr. E. LUCAS, it was resolved "that the company hereby approves the Bill as introduced into Parliament entitled 'A Bill to empower the City of London Electric Lighting Company, Limited, to acquire lands and work generating stations and for other purposes,' subject to such additions, alterations and variations as Parliament may think fit to make therein."

Stock Exchange Notices.—The Stock Exchange Committee has appointed Wednesday, March 28th, a special settling day in:—British Electric Traction Company, Limited—Further issue of 20,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 90,001 to 110,000. Castner-Kellner Alkali Company, Limited—£150,000 4½ per cent. first mortgage debenture stock, and has ordered the same to be quoted in the Official List.

Robey & Co.—The report of the directors for 1899 states that, after writing off £6,106 for depreciation, there remains a net profit of £36,860. Deducting debenture interest and adding £351 brought forward, there is a balance of £30,256 available, from which the directors recommend a dividend of 6 per cent, £16,699; to add £11,000 to the reserve fund (increasing it to £40,000), and to carry forward £2,557.

Commercial Cable Company.—The accounts of this company for the year 1899 show that after paying dividends amounting to 8 per cent., placing $150,000 to reserve for insurance of stations, apparatus, and repair steamer, and transferring $350,000 to the reserve fund, there remains a balance of $228,063 to be carried forward. At December 31st, 1898, a balance of $404,462 was brought forward.

The Hove Electric Lighting Company, Limited.—An extraordinary general meeting of this company was held on Thursday last week to approve certain alterations in the articles so as to comply with Stock Exchange requirements.

Richmond Electric Light and Power Company, Limited.—The annual meeting of this company was held at the offices, Moorgate Court, E.C., on Monday, to pass the report and accounts. The proceedings were conducted in private.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending March 17th, 1900, were £212 7s. 2d.; receipts for corresponding period, 1899, £236 9s. 6d.; aggregate for half-year to date, £1,684 9s. 6d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending March 16th, 1900, were £2,718 10s. 11d.; corresponding period, 1899, £2,709 16s. 0d.; increase, £8 14s. 11d.

The City and South London Railway Company.—The receipts for the week ending March 18th, 1900, were £1,452; ditto March 19th, 1899, £1,099; increase, £353. Total receipts for half-year, 1900, to date, £18,227; corresponding period, 1899, £12,242; increase £965. Miles open March 18th, 1900, 3½; March 19th, 1899, 3½.

The Dover Corporation Tramways.—The receipts for the week ending March 17th, 1900, were £135 2s. 1d.; March 18th, 1899, £141 18s. 5d.; decrease, £6 16s. 4d. Total receipts to date, 1900, £1,586 10s. 4½d.; corresponding period, 1899, £1,571 19s. 8d.; increase, £14 10s. 8½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,581; 1899, 4,358. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, March 16th, 1900, were as follows:—D. U. T. Co., horse cars, £48 18s. 1d.; ditto, electric cars, £2,941 18s. 11d.; D. S. D. Co., electric cars, £669 19s. 5d.; total, £3 663 16s. 5d.; corresponding week last year—D. U. T. Co., horse cars, £1,723 0s. 10d.; ditto, electric cars, £1,001 19s. 2d.; D. S. D. Co., electric cars, £699 9s. 2d.; total, £3,424 9s. 3d.; increase, £239 7s. 8d. Aggregate to date, £37,387 3s. 10d.; aggregate to date last year, £34,737 9s. 7d.; increase to date, £2,649 14s. 3d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending March 18th, 1900, were £537; week ending March 15th, 1899, £315; increase, £222. Number of cars, 1900, 28; 1899, 15. Total receipts to date, 1900, from April 1st, 1899, £29,185; ditto. 1899, from June 29th, 1898, £10,899. Miles of track open, 1900, 12; 1899, 6¾.

The Liverpool Overhead Railway Company.—The receipts for the week ending March 18th, 1900, amounted to £1,340; corresponding week last year £1,369; decrease, £29. Total increase in traffics for half-year to date, £1,290.

The South Staffordshire Tramways Company.—The receipts for the week ending March 16th, 1900, were £646 9s. 10d.; March 17th, 1899, £615 14s. 6d. Aggregate receipts for 11 weeks, £6,602 5s. 5d.; last year, £6,550 0s. 1d.

STOCKS AND SHARES.

Wednesday Evening.

WITH the release of a good deal of public money that had been locked up temporarily in applications for the National War Loan, the money market has become slightly easier than it was when we wrote a week ago. This, however, has not tended to encourage Stock Exchange business to any extent, and the prophets who foretold that disappointed applicants for "Khakis" would turn their attention and their money to the markets of Capel Court are looking rather unhappy at the failure of the prognostications to prove correct, up to the present, at all events.

But the electric lighting market has not much to grumble about! A good many shares are now changing hands every day, and although prices show but trifling alterations on the week, the variations are in each case upwards. City of London are again to the fore. It is a remarkable fact that the price of these shares is frequently widely different on one side of the market in the Stock Exchange to what it is on the other. For instance, a broker who wanted to deal in "City lights" was told by one dealer on Tuesday that the price was 9⅞ to 10⅛, and by another on the opposite side of the market that it was 10¼ to 10½. In this case the quotations obviously admitted of profitable arbitrage dealings by a shrewd broker. A good deal of curiosity is manifested as to when the new issue of capital, foreshadowed in the company's report, will be made.

Metropolitans are being inquired for, a steady stream of small orders to buy being a feature of the market. The price of the shares is now comparatively low, and considering that the company made nearly £12,000 more profit in 1899 than it did in the preceding year, the pessimists certainly do not have it all their own way when they draw gloomy pictures of the Metropolitan's future from the fact that about a quarter of a million sterling in new capital has been necessitated by the erection of the new works. The 3½ per cent. mortgage Debenture stock has risen a point. London Electric Preference are also higher, although, of course, no dividend is to be paid on the Ordinary shares. A profit of £25,412 was made for 1899, and the extra plant ordered by the company two years ago should now be practically all laid. Shareholders must not be surprised, however, if the denomination of their shares undergoes yet another change.

City and South London Ordinary has again risen two points, making 5½ in the past fortnight. The Moorgate Street Extension has come as a boon and a blessing to stockholders. The directorate have other irons in the fire, which, we trust, may be equally satisfactory. The subway at London Bridge, joining the City and South London with the Brighton Railway, the arrangements for meeting traffic from the Waterloo and City Company at the Bank, and other connections with the Great Northern at Old Street, to say nothing of the Baker Street and Waterloo line at the Elephant and Castle, should all help to bring the pioneer company into that state of prosperity which it richly deserves. Some of these schemes are only projected, but the more important connections are all being hastened forward. The stocks and shares of the Waterloo and City and the Central London show no quotable change.

In the manufacturing section Callender's Cable Construction are up ½, and are likely to experience a steady advance for some time to come, in our opinion. By the way, we really think it is quite time that the Stock Exchange Committee stopped quoting Greenwood and Batley Preference as "10 to 12." This has been going on for the past three or four weeks, and the odds are too long to last for ever.

Indo-European shows a rise of £3 per share, consequent upon the extension of the company's Russian concession for another 20 years, to which we drew attention last week. The African stocks are very quiet, and Eastern Ordinary at 15⅞ does not look expensive. Readers of ours who bought Anglo-American Preferred on our advice some weeks ago, can now secure a substantial profit, but we would advise them to keep the stock, as it will probably go to 120. Commercial Cable 4 per cent. Debenture stock is being bought by investors.

British Electric Traction new Preference are not to settle, after all, for the present. A special settlement was announced, but is now withdrawn. The Ordinary are quiet, and not very much business has been transacted in the shares this week.

The interests of the electric supply companies are not likely to suffer from the fact that one of the new members just elected to the Stock Exchange Committee is a broker whose name is widely known in connection with the Brush Electrical and its kindred companies.

awaiting connection 22,000. The capital expenditure had exceeded

find just the same difficulties with plant and coal, and he would

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, March 14th.	Closing Quotation, March 21st.	Business done during week ended March 21st, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	63 — 66	63 — 66	64	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	115 —116	116 —117	116⅝	115⅝
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s	14 — 14½	14½— 15	14⅝	14½
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,382,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	..	...	103 —105	103 —105	103	104
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½%	1 %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	19⅝	...
12,981	Direct Spanish Telegraph	5	4 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	..	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101—105%	101 —105%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	11½— 12	11½— 12	11⅛	11½
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	155 —160	155 —160	157½	155
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	99¼	99
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	116 —121	116 —121	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	...	16 — 16½	16 — 16½	16½	16 3/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	100 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	115 —120	115 —120	117½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	...	11½— 12	11½— 12	11⅞	11 13/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15½— 16	15½— 16	15 15/16	15⅞
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	...	...	31 — 33	32 — 34	...	...
86,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	50 — 54	54 — 58	58	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	104 —107	104 —107 xd	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	...	⅛— ¼	⅛— ¼	...	...
88,492	Do. do. 5% Pref., Nos. 1 to 88,492	1	4 %	4 %	2½%	⅛— 1	⅛— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5⅛— 5⅛	5⅛— 5⅛	5⅛	5
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	98⅜	97½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅜— 1	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	...	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	126 —131	126 —131	...	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	4⅜	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	96 — 99	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	100 —104	100 —104	100⅛	...
205,993	Western Telegraph, Ltd., Nos. 1—205,993	10	...	...	...	14⅜— 15⅛	14⅜— 15⅛	15⅛	14⅞
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	8%	...	...	⅞— 1⅛	⅞— 1⅛	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	...	...	9½— 9¾	9½— 9¾	9¾	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	...	...	7 — 8	7 — 8	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	...	...	100 —104	100 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	...	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	...	...	8½— 9½	8½— 9½	8¾	8 11/16
30,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10 xd	9 — 10	10	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9 — 10 xd	9 — 10	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
84,000	*Chelsea Electricity Supply, Ord.,	5	6 %	6 %	6 %	7 — 8 xd	7 — 8	7 7/16	...
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	...	...	110 —112	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	10 %	6 %	4 %	9½— 10½	9½— 10½	10⅜	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9½— 10½	9½— 10½	10 5/8	9¾
20,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12½— 13½	12½— 13½	13⅛	13⅜
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	109 —112	109 —112	110½	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1⅞— 2⅛	1⅞— 2⅛	2	1 7/8
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5	4½— 5⅛	5⅛	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	..	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13½— 14½xd	14⅜	14⅛
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13½— 14½	13½— 14½xd	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	114 —117	114 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	95 — 97	96 — 98	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½xd	15½— 16½xd	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14 — 15	14 13/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	9¼	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3¾— 4¼	3¾— 4¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	12 %	13 %	13¼— 14¼	13¼— 14¼	14¼	14

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotation Mar. 14th	Closing Quotation Mar. 21st.	Business done week ended Mar. 21st, 1900.	
		‡	1897.	1898.	1899.			Highest.	Lowest
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	...	...	2⅜ — 3¼	2⅜ — 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	6 %	...	17 — 18	17 — 18	17⅝	17½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13 — 13½	13 — 13½	13½	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
45,000l	†British Electric Works Co., Ord. £1 shares, 50,001—95,000	...	...	...	...	1/16 — 1 1/16	⅞ — 1	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅜ — 1	⅜ — 1	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	5⅝ — 6½	6 — 6¼	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	3 %	5 %	...	1⅞ — 2⅛	1⅞ — 2⅛	2 1/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2¼ — 2½	2¼ — 2½	2⅜	2 5/16
125,000l	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —113	108 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½ %	15 %	...	14 — 15	14½ — 15½	15⅝	15½
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅝ — 6	5½ — 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	111 —115	111 —115	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9⅜ — 10½	9⅜ — 10½	10⅛	10 1/16
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5½	4⅜ — 5¼	...	...
71,447	Do. do. Def. do.	5	...	...	...	4⅜ — 5½	4⅜ — 5¼	...	...
855,000	City and South London Railway	Stock	1⅞ %	2⅛ %	1⅞ %	64 — 68	66 — 68	68	66½
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd.	10	...	...	...	4½ — 5½	4½ — 5½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4	3½ — 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 —101	98 101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2½	2 — 2½	...	...
17,189	Do. do. do. "A" Shares, 01—017,189	5	6 %	6 %	...	3½ — 4½	3½ — 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 95	93 — 95	94	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	2 3/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2⅜ — 3½	2⅜ — 3½	...	...
140,800	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600l	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	...	13½ — 14½xd	13½ — 14½	14	...
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼ — 5⅝xd	5¼ — 5⅝	5½	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21½	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3½ %	3½ %	8⅜ — 8⅞	9⅛ — 9⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	12⅝ — 13½	13 — 13½	...	...
37,850	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40 xd	36 — 40	37	36
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...	5	...	...	...	9 — 10	9 — 10	9½	9½
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000l	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	101 —104	101 —104	103½	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 101—104.
National Electric Free Wiring, 12/6 paid. ¼—⅜.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10½—10⅝.
Smithfield Market Electric, 2—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 7⅞—8. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6¼.
*T. Parker, £10 (fully paid), 18.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (January 25th, 1900).

MARKET QUOTATIONS, Wednesday, March 21st.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a ,, ,, ...	per ton	£27	£27	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	£2 inc.
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	4½d.	..
a ,, Caustic (75/80 %) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
a ,, Bichromate, casks ..	per lb.	3½d.	3½d.	..

METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b ,, Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£85 to £165	£85 to £165	..
c Brass (rolled metal 2" to 12") basis	per lb.	8d.	8d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	9d.	9d.	..
c ,, Wire, basis	per lb.	8½d.	8½d.	..
c Copper Tubes (brazed)	per lb.	11½d.	11½d.	..
c ,, ,, (solid drawn) ..	per lb.	11½d.	11½d.	..
g Copper Bars (best selected) ..	per ton	£88 10	£88	10s. inc.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£88 10	£88	10s. inc.
g ,, Rod	per ton	£88 10	£88	10s. inc.
c ,, (Electrolytic), Bars ..	per ton	£85	£85	..
c ,, ,, Sheets..	per ton	£94	£94	..
c ,, ,, Rod ..	per ton	£88	£88	..
c ,, ,, H. C. wire	per lb.	10d.	10d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	4/4 to 4/4½	4/3½	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	73/6	72/-	1s. 6d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72 6	..
i ,, Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 15	£16 15 6 to £16 17 6	dec.
g ,, ,, Sheet	per ton	£18	£18	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd str'p & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£3 12	£3 12	..
p Silicium Bronze Wire	per lb.	10½d. to 1/-	10½d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£140 to £141 nom.	£143 to £144 nom.	£3 dec.
g ,, foil	per lb.	1/9	1/9	..
n ,, wire Nos. 1 to 16	per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea. ..	per lb.	6d.	5½d.	½d. inc.
j ,, Hemp, 8 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs.	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£15 10	£15	10s. inc.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27 5 nett.	£27 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

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k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. F. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON THE APPLICATIONS OF ELECTRICITY IN MEDICAL AND SURGICAL PRACTICE.

By H. Lewis Jones, M.D., Medical Officer in charge of the Electrical Department in St. Bartholomew's Hospital.

(*Paper read March 8th*, 1900.)

(*Concluded from page* 461.)

When simple stimulation is required in the treatment of a case, the induction coil is probably the most convenient and cheap method of procuring it. The battery current has a superiority in certain things, for example, it gives a wider range in degree and quality of stimulation; and certain living tissues respond better to battery currents slowly increased and decreased than they do to the sudden jerks of the coil. The intense effect of the coil on the sensory nerves of the skin makes it difficult to use coil currents of sufficient strength to penetrate to the deeper parts of the body, and for deep parts currents of large magnitude are necessary to make up for the weakening effect of diffusion.

The strength of current used in treatment ranges between 4 and 40 milliamperes for the most part, though smaller and larger currents are sometimes used. The larger the currents the larger should be the surfaces of the electrodes.

The measurement of induction coil currents presents difficulties which have not hitherto been surmounted, and the rough comparisons which are made by means of a scale of millimetres at the side of the sliding secondary cannot be translated into units and cannot be trusted to be alike for two consecutive days. Instruments which measure the mean current are of no use, because the physiological effect does not depend upon mean current, but upon the rate of change and the maxima. The use of a sinusoidal current from a dynamo, to take the place of the induction coil, might enable one to evade the difficulty, but the dynamo current of the mains, in certain cases at least, produces such painful skin effects as to be very unpopular with patients. It is difficult to say why this is so, but the subject wants further study.

Possibly the use of condenser discharges, the condenser being automatically charged and discharged rapidly, might meet the difficulty of producing a current which would resemble that of the coil in its physiological action, and would allow of measurement. I would like to ask the advice of members of the Institution on this point: Would not the curve of discharge of a condenser have a close resemblance to the discharge curve of an induction coil? Could not one arrange a condenser of small capacity, such as a Leyden jar of diminutive size, and employ some very fine adjustment of spark gap for measurement and regulation? I have thought that in this way, using high voltages and small capacities, the disturbing factor of varying skin resistance would become comparatively unimportant.

Current from the Mains.—After its introduction into commerce the current of the electric lighting mains was quickly introduced into medical practice, and we make large use of it in the Electrical Department of St. Bartholomew's, which is connected with the mains of the City of London Electric Lighting Company. The current impulses from the alternating mains have physiological action resembling those of the induction coil—that is to say, the effect upon nerve and muscle is to produce a permanent contraction so long as the current is applied. But it is superior to the induction coil in being a less violent stimulus to nerve and muscle by reason of the more even and gradual rise and fall of its waves. Larger currents can be borne than from the induction coil, and, judging from its effects in a long series of cases, it appears to be more thorough and more useful in its effects. Nearly all the cases formerly treated by the induction coil at the hospital are now treated by the current from the mains, the voltage being lowered to suit the requirements of the case (to about 10 volts as an average), and indirectly we have gained largely in that the department is now free from the noise of eight or ten induction coils all vibrating and buzzing at once. Formerly the effect of that noise during a long afternoon was most trying. There is one marked difference in the effect of the alternating current which limits its use, and that is, that, if applied in the ordinary manner through moistened electrodes to the surface of the skin, it has a peculiar, disagreeable, burning effect. The more thoroughly the skin is moistened, the less this is noticed, and when the current is conveyed to the patient through the medium of water, as in a bath, this disagreeable cutaneous effect disappears entirely. Consequently a mode of treatment by means of baths and the sinusoidal current has been developed to a very considerable extent, and with decided advantage to our patients. Large numbers of our cases are cases of paralysis of the upper limbs from injury or disease of the nerves of the upper extremities, and for these we use an arm-bath. The arm-bath is a stoneware trough, of suitable shape, having a metal electrode at each end, it is filled with warm water, into which the patient plunges the forearm and hand. The use of hot water as a medium for conveying electricity to a patient has many advantages. The current is much better borne, and therefore a stronger current can be used. Manipulation of the electrodes and personal handling of the patient is done away with, and the affected part is kept warm during the application. For these reasons we use it largely, and I continue to advocate its use as one which again is likely to increase the popularity of electricity among the medical profession, because it tends to simplify its mode of application. In addition to small local baths for parts of the body, we have a large bath, in which the whole of the body is immersed; and for general morbid conditions, as distinguished from local ones, the electric bath with the induction-coil current, or better still, with the sinusoidal current of the mains, is an extremely useful contrivance. In that section of medical electricity which comprehends general applications for general systemic diseases—a field of work which is only now being thoroughly explored—the electric bath is perhaps superior to any other mode of applying general electrification. The other modes of doing this are by the statical machine, or by the high frequency and high potential methods of Tesla and of D'Arsonval. The chief advantage of both these latter methods is that the patient need not disrobe; but on the other hand, the electric bath has the great advantage that the currents which are being used can be more readily measured and adjusted to suit individual needs. Chance very largely decides the choice of one or other of these methods of general electrification. Whereas the sinusoidal current and the bath suits one medical man best, the other forms may be more convenient to the conditions of practice of another one. The electric bath, unfortunately, has been rather under a cloud during recent years, in this country at least, by reason of its association with those peculiar "massage" establishments which sprang up so thickly in London a few years ago. Now, however, most of these establishments have disappeared, and one may venture to speak of the definite advantages of the electric bath without feeling that one's words may reappear in the columns of some journal in association with advertisements of undesirable houses. At St. Bartholomew's Hospital, excluding arm baths, about 1,000 baths, mostly with the sinusoidal current, are given each year, particularly for diseases like debility, rheumatism, sciatica, neuritis, lead-poisoning, and various forms of paralysis. No electrical department can be considered properly equipped without the electric bath, for in many morbid states its action is most valuable. The bath with direct current has also certain useful applications, although not so many as the induction-coil or the sinusoidal current bath. The direct current bath, local or general, is useful in the relief of gout, rheumatism, sprains, chronic inflammations, and generally as an absorbent for the removal of fibrous adhesions or thickenings in or about the joints and limbs. It is also indicated in painful states, when a varying current is too stimulating to be well borne, as, for example, in acute sciatica, neuritis with pain, and so on.

The alternating current of the mains also lends itself extremely nicely to such uses as for galvano-cauteries and for the small exploring lamps used by surgeons, and where alternating current is laid on they now for the most part have small transformers for use in this way. Instruments containing lamps and telescopes are now used for examining the interior of such cavities as the bladder and the stomach, which previously have been inaccessible to the sight, as well as for the illumination of more accessible parts, such as the throat, the ear, the nostrils, &c.

The arrangements at St. Bartholomew's for the distribution of our current from the mains consist of a transformer tapped at intervals in its secondary winding, and led to a row of binding screws, from which any voltage, between ½ a volt and 50 volts, can be taken at will. The three rooms in which treatment is given are wired in three circuits, as for electric lighting, and the voltage required can be switched on to any of the three rooms from the transformer. Thus we have at command low voltage currents for galvano-cauteries and small lamps, and higher voltage currents for applications to patients. We use 3 or 4 volts for cauteries, 8 or 10 for lamps, 10 to 20 for the baths. Several of our old sledge-pattern induction coils, with sliding secondaries, are now converted for use as subsidiary regulating devices for the baths. I cannot say much of the use of direct-current mains in medical practice from personal experience. Although I have been instrumental in connecting three places to the lighting mains, I have never been in touch with direct-current circuits. The use of the direct current from the mains for applications to patients, and for other applications requiring low voltages, is carried out either indirectly by means of charging accumulators from the mains and using them, when disconnected, for the patients, or else by means of shunt resistances. The latter method is to provide a resistance of several thousand ohms, which is connected across the mains. The resistance is a bare wire coiled on a support, and is fitted with a travelling contact-shoe which can be moved so as to tap the windings at any point. The patient is arranged in a shunt circuit in parallel with any convenient length of the resistance. When only small currents are required, a lamp is arranged permanently in series with the wire resistance. The slope of potential which can be tapped at different points by the movements of the slider permit fine regulation of current in the shunt or patient's circuit. With shunt resistances of suitable magnitude current can be obtained for treatment, for working induction coils, or for galvano-cauteries. In the latter case the waste is considerable, and it is my belief that an accumulator charged through a lamp would be much better, but in many cases the shunt circuit is preferred, in spite of its waste at the rate of more than a horse-power, whenever 10 amperes are wanted. Possibly something like a step-down induction coil might be devised for heating cauteries off the direct-current mains. One of the drawbacks of electric light supply is that those who have continuous current laid on cannot also have alternating. And so a medical man residing in a district supplied by direct current will have to generate any sinusoidal current needed by means of a motor dynamo. These instruments can be bought and are in use. On the other hand, a medical man supplied with alternating current will often sigh and wish that he could easily generate for himself a little continuous current. And here is a point which perhaps might be worth the attention of this Society, viz., the contrivance of some simple rotary converter which could be attached to a lamp socket in a house supplied with alternating current, and which would give out continuous current, sufficient to recharge a portable accumulator from time to time. Not much would be wanted, and perhaps it is just on that account that the instrument I have indicated is not easy to get; presumably it would not pay to make it. Still, a little rotary transformer, which would give out, say, an ampere at 10 volts of continuous current, would be welcomed by many medical men who live in districts of alternating supply. The mechanical efficiency of the machine is in

no way important, considering the smallness of the needs. That which would be important with such an instrument is that it could be left to run for periods of an hour or two at a time without needing its owner to stand over it and watch it, and that it would not become over-heated nor make a great noise.

The Statical Machine.—This form of apparatus—the first introduced into medical practice—is showing very decided signs of a revival. In the United States the statical machine is already very largely employed, and I am told that in New York alone there are no less than three firms busily engaged in turning out statical machines at the rate of two or three a week. Those who are only acquainted with the effects produced by small statical machines can have no idea of the difference between small and large instruments of this kind. The effects produced by a large statical machine are most decided, and it is only necessary for one to experience them once to see that treatment by them is by no means a mere treatment through the imagination. The most apparent effects of the statical machine are the profound and peculiar cutaneous sensory stimulation which can be produced by it, and the forcible muscular contractions which can also be produced by it when the administration is in the form of sparks. Its special field of usefulness probably lies, first, in its action as a general excitant; secondly, in conditions of neuralgia and other superficial pains; thirdly, in the conditions of muscular pain. In all these cases it acts quickly and thoroughly. It is quite common to receive a patient stiff and lame from lumbago or muscular rheumatism, and to see him leave in 10 or 15 minutes quite free, for a time at least, from his lameness or his stiffness. All this promises to be extremely valuable. The difficulty of understanding how a simple electrification by the static machine can influence the body makes many of us disinclined to believe that there can be any effect; but after watching cases carefully for some time, I can now say with certainty that some direct action does take place. I have only had a proper static machine for a year and a half, and therefore still feel rather a beginner with it. A very interesting matter is that, whereas on the other side of the Atlantic the influence machine which is used is invariably a modified Holtz's, on this side it is the Wimshurst, which is considered the best. The American Holtz machine certainly has been developed into a most beautiful instrument, and although it has one drawback when compared with the Wimshurst—that of not being self-exciting—that is a point so easily got over by means of a small accessory exciting machine in the corner of the case, as to have no real importance. Size for size, I am disposed to believe that the Holtz gives a better output than the Wimshurst. It appears to be a more cheaply constructed machine, and needs no countershaft nor cross-belts. Recently a large American Holtz machine has been presented to St. Bartholomew's Hospital, so we shall have an opportunity of testing and of comparing its work with that of a large Wimshurst machine which I have recently had constructed for my own use. As a good Holtz machine is, so far as I know, a curiosity in this country, I shall have much pleasure in showing our machine to any members of the Institution who might wish to see it. The accessory apparatus and the technique of the statical machine have been very greatly simplified by the work of American physicians.

The application of high frequency currents to medical practice has not had much extension. In France it is used a little. The currents are taken from leads connected to the ends of the primary helix, and no secondary coil is used. An induction coil is generally used to charge the Leyden-jar condensers of the system. The applications are either by a sort of spark or brush discharge from one terminal to the patient; or the patient lying on a couch is attached to one pole, the other being connected to a sheet of metal under the couch. This is called the condenser bed. Finally the patient may be enclosed in the actual helix connecting the jars, and his body thus made the seat of induced currents by "auto-conduction." Its chief applications have been as a mode of general electrification, but the brush discharge is also applied locally to the skin, and has seemed efficacious in curing certain skin diseases.

Ozone.—The use of electricity for generating ozone for medical purposes is attracting some interest. It is not so much that these applications of ozone are entirely new, as that the apparatus is now becoming sufficiently improved to make its applications easier. But the rapid development of electricity in so many directions of late years has given medical men just at present so many fresh things to handle, that ozone, in its medical applications is, as it were, waiting until some one has time to attend to it. The workers in medical electricity, in this country at least, are so few.

Perhaps the most striking of all the applications of electricity to medical work in recent times has been due to the discoveries of Prof. Röntgen. The introduction of the X rays has revived very greatly the interest in medical electricity.

The Röntgen-ray work makes a very considerable addition to the work done in our electrical department at St. Bartholomew's Hospital, as it is in almost daily use for purposes of diagnosis in surgical cases. Physicians hitherto have paid but little attention to Röntgen rays, but its application to the diagnosis of diseases of the chest must be mentioned as perhaps one of the most promising things for the future. Certainly it is possible to diagnose pulmonary consumption and some other diseases of the chest more satisfactorily, and at an earlier state of the disease, by the X rays than is possible with the stethoscope; and this one point alone appears to me to be of the highest importance. For example, recently I saw the X-ray photograph of a patient's chest. She was suspected of having pulmonary disease, and was sent to one of my colleagues for an X-ray photograph; examination by the ordinary methods of auscultation and percussion had given an uncertain reply. But the negative taken with X rays showed without any possible doubt the presence of tubercles in the lung. If there were more time to spare I could go into the question of X-ray work more deeply on the grounds of its great development by medical practitioners, the localisation and stereoscopic methods of Dr. Mackenzie Davidson and others being singularly beautiful in their results; but I have the idea that most of us are a little sated with X ray work just now, so I shall say no more, except to refer to the extreme beauty of the fluorescent screen effects which are given by large static machines.

COAL ANALYSIS.

II.

When coals contain less than 2 per cent. of moisture, satisfactory results can be obtained by drying for 24 hours in a watch glass over sulphuric acid at atmospheric pressure, but this method is not satisfactory for lignites or coals with high moisture percentage.

It is found to be most difficult to grind coals without serious loss of moisture when this is carried out in a mortar.

Thus when coal was coarsely ground in a coffee mill and then finely reduced in a mortar as quickly as possible and put into a stoppered tube, the coal ground once in the mill lost in 24 hours over sulphuric acid in vacuo 14·03 per cent; that twice milled lost only 13·88 per cent., while that ground in the mortar lost only 13·62, showing by the difference what had disappeared in the process. Another coal lost similarly 1·26, 1·24 and 1·07 per cent., which serves to indicate that the mortar is hardly reliable, allowing so much drying to take place during the operation.

It is considered that the testing of moisture may well be made the subject of additional research, and every coal analyst should be most careful that his methods do not cause serious loss of water prior to the determination.

Volatile combustible matter is determined by placing one grain of fresh undried powdered coal in a platinum crucible with a tightly fitting cover and heating for seven minutes over the full flame of a Bunsen burner, the bottom of the crucible being 6 to 8 centimetres above the top of the burner; the flame of the Bunsen when free should be at least 20 centimetres high, and in a place free from draughts. The percentage of volatile matter is the difference between the loss and the already determined percentage of moisture. Another method of making this determination is to place the crucible 3 centimetres above the burner, but is not thought to be so good as the above. The flame is better at the higher elevation. In any case, there is a large element of doubt, which arises from the fact that volatile hydrocarbons may be split up by the heat, and the carbon thus set free remains behind in the crucible. The carbon also holds hydrogen to a considerable extent, and this is only expelled as the temperature is successively augmented. It is thus quite apparent that whatever the method pursued this determination can only be an arbitrary one, and the committee recommend their method as approximating the methods used in the commercial manufacture of coke, while it is one that can be used by different operators so as to obtain concordant results. It is objected that even non-coking coals suffer loss from rapid heating, but this is not substantiated.

It is found that the percentage of coke yielded by slow heating is increased over that produced when rapid heating is practised. Thus where a 7 minutes' heating by a full Bunsen flame gave 67·76 per cent. of coke, in a certain instance a slow heating of 5 minutes in an inch flame and 5 minutes of full flame gave 72·88 per cent. of coke, while only 67·71 per cent. was given when the coal was heated 3½ minutes in the full flame and the same time over a blast. Other coals gave corresponding results, all showing the advantage of slow heating. The average yield of coke was 4·58 per cent. greater with the slower heating.

Practically, no difference in coke production was found as between coals dry or wet, and the determination of the coke should be made from the undried samples, thus corresponding with the methods of commerce.

Ash.—The determination of ash is better made from the powdered coal than by continuing the heating of the coke left by the determination of the volatile matter. The sample is burned first over a very low flame with the crucible open and inclined. The ash may be examined for unburned carbon by moistening it with alcohol. The presence of sulphur as pyrites is a cause of slight indeterminateness, for the pyrites is converted almost wholly to ferric oxide, and as three atoms of oxygen replace four of sulphur, the weight of ash is less than the weight of mineral matter by five-eighths of the weight of the sulphur. After all it is not quite fair to include the sulphur in the ash. Sulphur has some heating effect, and the oxygen locked up in the ferric oxide must give up its heat of gasification in becoming solid.

Fixed Carbon.—This is determined by taking the difference between the coke and ash.

Sulphur is determined by Eschka's method. One gramme of finely powdered coal is mixed with one gramme of magnesium oxide and half a gramme of dry sodium carbonate in a platinum dish of 75 to 100 cc. capacity. The magnesium oxide ought to be of the light and porous variety.

The dish is heated over an alcohol lamp (not over a gas flame, which itself contains sulphur). It is slowly raised to a red heat, the contents being stirred with a platinum wire. The heat is continued until the bottom of the dish is at a low dull red heat. When the carbon is burned the mass is transferred to a beaker, and the dish rinsed with 50 cc. of water, to which is then added 15 cc. of saturated bromine water, and the whole is boiled for five minutes, then settled and decanted through a filter, and boiled a second and a third time with 30 cc. of water, and washed till the filtrate gives only a slight opalescence with silver nitrate and nitric acid. The volume of the filtrate should be about 200 cc. To this is added 1½ cc. of

concentrated hydrochloric acid, or 8 cc. of 8 per cent. diluted acid. The mixture is then boiled to expel the bromine, and to the hot solution is added, drop by drop, with constant stirring, 10 cc. of 10 per cent solution of barium chloride. Digest on a water bath, or a low flame, with occasional stirring, until the precipitate settles clear quickly, then filter and wash, using a Gooch crucible or a paper filter. Ignite this latter moist in a platinum crucible with a low flame until the carbon is burned.

Where the coal contains much pyrites or calcium sulphate, the residue of magnesium oxide should be dissolved in hydrochloric acid, and the solution tested for sulphuric acid.

Ultimate Analysis.—In determining carbon and hydrogen, lead chromate or other means of retaining sulphur must be used. Nitrogen is so small, that the use of a copper spiral is unnecessary.

The calculation for oxygen is one of the worst difficulties. If it could be relied on that all the sulphur was present as pyrites, and all of it had been converted to ferric oxide in the ash, then the oxygen could be found by subtracting from 100 the sum of the carbon, hydrogen, nitrogen, ash, and $\frac{8}{15}$ths of the sulphur, and probably, for coal high in sulphur, no better rule can be given. But the chemist must be satisfied that the ash is free from sulphates and also that the sulphur is mainly in the form of pyrites.

Heating Effect.—Originally it was recommended that the heating effect be given on the basis of the coal burned to water vapour at 100° C. It is now recommended that results be given in terms of heat available with water liquid at ordinary temperature. This at least shows what possibilities there are in the fuel if utilised to the ultimate degree. The method agrees with the results of the bomb calorimeter, and will therefore be more usefully comparable.

The most reliable formula for heating effect is probably that of Dulong, which gives the heating effect in calories per kilogramme as

$$\text{Calories} = 8{,}080\ C + 34{,}460\ (H - \tfrac{1}{8}O) + 2{,}250\ S.$$

The theoretical evaporative effect is calculated by dividing the calories per kilogramme by 536, or the British thermal units per pound by 965, and subtracting from the result $\frac{1}{15}$th more than the amount of water formed by burning 1 kilogramme or 1 lb. of the coal. The $\frac{1}{15}$th is added because the liquid water on the basis of which the formula is given is supposed changed for steam at 100° C. For most coals the amount to be subtracted is to be taken as 0·55 when the result gives the evaporation from and at 100°.

The average of a series of American bituminous coals gave results, closely corresponding with the results of the bomb calorimeter, and the coals varied from 7,847 to 8,792 calories. It is observed that the same seam of coal gives closely concordant results over wide areas.

The value of a fuel, as shown by the six examples given in the table, is obviously closely dependent upon the percentage of oxygen present, as might be expected. Approximately the value of a coal in calories is almost 100 times the carbon percentage it contains.

No. of samples.	S	C	H	O	N	Calories by bomb.	Calories calculated.
3	1·59	80 63	5·40	12 26	1·71	7,860	7,847
2	3 01	82 15	5 36	10 97	1·53	8,148	8,012
9	2 20	83 66	5·51	9·33	1·51	8,255	8,255
15	2 29	83·97	5·60	8·79	1 66	8,372	8,335
2	0 28	85·93	5 47	7 06	1·54	8,508	8 523
3	0 59	91 28	4 52	3·29	0 91	8,783	8,792

The combustible matter in a coal can be closely estimated by subtracting from 100 the percentages of ash, moisture, and half the sulphur or five-eighths of all the sulphur if in pyritic form.

We may add that Atkinson's method for sulphur determination is as follows:—1 gramme of finely ground fuel is mixed with 5 grammes of dry sodium carbonate on a flat platinum dish on a hot but black muffle, which is raised to a clear cherry red in about half an hour, and kept so another 10 or 15 minutes, but it must not be so hot as to fuse the soda, and the mass must not be stirred. When the carbon is all burned off, in about 45 minutes the mass is allowed to cool and is digested in 100 cc. to 120 cc. of warm water, settled, decanted through a filter and washed twice by decantation and then on the filter adding a few drops of solution of pure sodium chloride if the residue tends to pass through the filter. The filtrate is acidified with 12 cc. of concentrated hydrochloric acid and precipitated with barium chloride as above.

THE LAW RELATING TO PICKETING.

As the trades unions have abandoned their intended appeal in the case of Lyons *v.* Wilkins, attention is called by the Employers' Parliamentary Council to the judgment in this case, which is now the unchallenged declaration of the law relative to picketing. Section 7 of the Conspiracy and Protection of Property Act of 1875 reads:—

> Every person who, with a view to compel any other person to abstain from doing or to do any act which such other person has a legal right to do or abstain from doing, wrongfully and without legal authority . . . . watches or besets the house or other place where such other person resides, or works, or carries on business, or happens to be, or the approach to such house or place . . . . shall, on conviction thereof by a court of summary jurisdiction, or on indictment, as hereinafter mentioned, be liable either to pay a penalty not exceeding £20, or to be imprisoned for a term not exceeding three months, with or without hard labour.

This enactment is, however, limited by the following proviso:—

> Attending at or near the house or place where a person resides, or works, or carries on business, or happens to be, or the approach to such house or place, in order merely to obtain or communicate information, shall not be deemed a watching or besetting within the meaning of this section.

Previous to the action of Lyon *v.* Wilkins this clause has been held to legalise what is called "peaceful picketing," and though violence and intimidation were illegal, argument or persuasion by other workmen was allowed. But it is now construed that the words "to obtain or communicate information" are to be construed literally, and are not to be read as covering the totally different procedure of argument and persuasion. This was clearly raised in the course of the above action. The plaintiffs obtained an injunction to restrain the defendant from picketing their premises.

It was granted by Mr. Justice North and confirmed on appeal, and a perpetual injunction was then granted by Mr. Justice Byrne in February, 1898. The defendant again appealed, but judgment was upheld December 20th, 1898, and the abandonment of the threatened further appeal leaves the judgment now unchallenged. Obviously, therefore, it is now illegal to attempt to persuade a man to leave his employment by argument or molestation in the way of picketing at either the place of employment or residence. No person has a right to watch or beset such a place for the purpose of persuading a person from doing or leaving undone such things as he has a legal right to do or leave undone. Of course this does not apply to the right to conduct a public propaganda, to call meetings and give lectures or addresses to such as choose to *come* to hear. But the propagandist must not go to his victims; his victims must go to him, and where a workman has an injustice he wishes to be rid of, he will very soon be found to go. But no man must be beset for the purpose of persuading him to leave his employment. Picketing is, in fact, illegal, and will probably drop out of use altogether. It has always been an evil, and the moral suasion it has been intended to employ has far too frequently degenerated into the suasion of the brickbat and the bludgeon at the hands too frequently of ruffians who have hung on to the skirts of the respectable and quiet man, and perhaps brought a good cause into disrepute by the violence that has attended upon the evil system of pickets. We fully believe that respectable workers will profit equally with the employers by the abolition of picketing.

THE PRICE OF ELECTRICITY TO THE CONSUMER.

THE first statutory enactment which contains any provision as to the price to be charged for electricity furnished to the public, is Sec. 6 of the Electric Lighting Act, 1882 (45 and 46 V., C. 56). It is there provided (*i.a.*) that undertakers shall be subject to such regulations and conditions as may be inserted in any license, order, or special Act with regard to the limitation of the prices to be charged in respect of the supply of electricity.

According to Sec. 31 of the schedule to the Electric Lighting (Clauses) Act (1899), which is in future to be incorporated with all provisional orders outside the County of London, undertakers may charge ordinary consumers (otherwise than by agreement)—

1. By the actual amount of electricity so supplied; or
2. By the electrical quantity contained in the supply; or
3. By such other method as may for the time being be approved by the Board of Trade.

The exact prices which may be charged are now set forth in the fourth schedule to the *Form of Provisional Order* published by the Board of Trade in 1899. In that schedule the term "unit" means the energy contained in a current of 1,000 amperes flowing under an E.M.F. of 1 volt during the hour. When they charge by *actual amount* undertakers are entitled by Sec. 1 of the schedule to charge at the following rates per quarter:—For any amount up to 20 units, 13½d.; and for each unit over 20 units, 8d. Where they charge by the *electrical quantity* in the supply, they shall be entitled to charge according to the rates set forth in Sec. 1 of this schedule, the amount of energy supplied to the consumer being taken to be the product of that electrical quantity and the declared pressure at the consumers terminals as may be declared by the undertakers under the Board of Trade regulations. The "standard or declared" pressure at consumers terminals is also provided for by the Board of Trade regulations under the Electric Lighting Acts, 1882 and 1888, Sec. (B), Sub-Sec. 4—8. Should any consumer at any time object to the method whereby he is charged, he may by one month's notice require the undertakers to charge him *at their option* either according to methods (1) or (2). (See Sub-Sec. (2).)

The result of this sub-section is that the option lies with the undertakers, and the consumer has in reality very little power. Suppose, for instance, the majority of the consumers in a district were charged according to electrical quantity; an application by one or two to charge according to "actual amount" could apparently be refused.

After giving notice to the local authority or by public advertisement of the method whereby they propose to charge, that method cannot be changed unless a month's notice has been given to the local authority and consumers. (Sub.-Sec. (3).)

It does not follow that the price charged for electricity need necessarily remain uniform. Thus it is provided by Sec. 32, that although as a general rule the prices charged shall not exceed those mentioned in the special order (Sub-Sec. 1), readjustment may be had in the manner provided for in Sec. 2. An application for this purpose may be made either by the local authority or the undertakers

(in cases where the local authority are not themselves undertakers). The Board of Trade may make the alterations after such inquiry as may seem fit to them. Prices may be altered in this way after any or every period of seven years since they were last altered.

Authority to alter *prices* is thus vested in the Board of Trade, whereas the local authority has power to deal with and alter the standard pressure, subject to an appeal from their decision to the Board of Trade. (See rule 6 of the Regulations of 1896.)

By Sec. 33 it is provided that subject to his right to demand that he shall be charged according to one or other of the methods mentioned in Sec. 31 (1), and to the provisions of Sec. 20 of the Electric Lighting Act 1882, which guard against any undue preference being given to any consumer or class of consumers, the consumer may make what terms he likes with the undertakers. Where the local authority are not the undertakers, the price of the current supplied to public lamps is to be settled by agreement, subject to an appeal to the Board of Trade [Sec. 34.].

RECOVERY OF CHARGES.

Such being the rules and regulations which enable the undertakers to demand an adequate remuneration for the electricity supplied by them, it remains for us to consider the methods whereby they may enforce their rights in courts of law. As the method of supply, and the means of estimating the supply of electricity are similar to the method and means adopted in the case of gas, the legislature has simply applied the rules laid down in the Gasworks Clauses Act, 1847 (10 and 11 Vict, C. 15), substituting the word "electricity" for "gas," the word "electric line" for "pipe."

By Sec. 39 of the Gasworks Clauses Act, 1871, 34 and 35 Vict., C. 41, it is provided that if a consumer of gas leaves premises without paying the *gas* rent the undertakers may not, in the absence of agreement between the incoming and the outgoing tenant, demand payment of arrears from the incoming tenant. By reading together Sec. 40 of the Gasworks Clauses Act, 1871, and Sec. 12 (3) of the Electric Lighting Act, 1882, we find that if any person supplied with *electricity* neglects to pay the rent due for such electricity or for hire and fixing of the meter, or the expenses of the undertakers in lawfully cutting off the supply, the amount may be recovered from him in the same way not as a penalty but summarily as a civil debt. The recovery of civil debts in a court of summary jurisdiction is provided for by S.S. 6 and 35 of the Summary Jurisdiction Act, 1879 (42 and 43 Vict., C. 49).

The above method is in reality only an alternative one, for by Sec. 41 of the Gasworks Clauses Act, 1871, rents and sums due may be recovered with full costs of suit in any court of competent jurisdiction.

In addition to their remedies in courts of law, undertakers may bring pressure to bear upon consumers in order to enforce the payment of their just demands. Thus it is provided by Sec. 21 (of the Act of 1882) that they may cut off the supply to any consumer who refuses to pay his rent. This may also be done if leakage is discovered on the consumer's premises. [See Rule 42 of the Board of Trade Regulations of 1896.]

The following is a convenient form of notice which may be served upon a consumer in order to enforce payment of rent. The form is one in actual use:—

THE ——— ELECTRIC SUPPLY COMPANY.

[Address of works and offices.]

NOTICE TO DISCONNECT.

We hereby give you notice under Sec. 21 of 53 and 54 Vic., Chap. 186, that unless the sum of ——— is within seven days from the date of service hereof given as security for the payment of all monies which are and may from time to time become due in respect of the supply of electric energy, the company may discontinue such supply and will take action to recover all monies due.

PHYSICAL SOCIETY.

ORDINARY MEETING held March 9th, 1900.

Prof. EVERETT, F.R.S., Vice-President, in the chair.

A PAPER ON "THE DAMPING OF GALVANOMETER NEEDLES" was read by MR. M. SOLOMON.

The solution of the equation of motion for a magnetic needle, swinging in a uniform magnetic field, points to the conclusion that the ratio of the period to the logarithmic decrement is independent of either the moment of the needle, or the strength of the controlling field, and is simply a function of the damping coefficient and the moment of inertia of the moving system. This ratio should, therefore be constant if these latter quantities are constant. Experiments to test the constancy of period to logarithmic decrement have been conducted at the Central Technical College at various times since 1891, and they have invariably pointed to a variation in the value of the ratio. The object of the present paper is to discover the cause of this variation. It may be due to an alteration in the moment of inertia, or to an alteration in the damping coefficient. If the control magnets are either directly above or directly below the needle, there is no chance of any change in moment of inertia. The damping coefficient depends on three things:—(1) Viscosity of the air, (2) viscosity of the suspension, and (3) eddy currents. The author has carried out experiments with a galvanometer, on open circuit, and finds a constant value for the ratio. The viscosity of the air and suspension, therefore, cause no variation. Upon closing the circuit, and repeating the experiments, the value of period over logarithmic decrement alters. The variation is, therefore, due to eddy currents. The damping factor due to eddy currents may vary owing to three causes:—(1) change in moment of needle due to change in field strength; (2) effects of self-induction; (3) effects of rise of temperature on the resistance of the coils. The author points out that the two latter causes would tend to alter the ratio in the wrong direction, and he therefore concludes that the variation is due to an alteration in the strength of the swinging needle produced by altering the strength of the controlling field.

MR. BLAKESLEY, said, it was interesting to note the fact that the ratio of period to decrement was independent of the controlling field. In the case of a condenser discharging, this ratio is independent of the capacity, in the case of a tuning fork of the rigidity, and in the case of water oscillating up and down in a U tube of the acceleration due to gravity.

Mr. ROSENBAUM said that the ratio considered was constant in the case of a Nalder-D'Arsonval galvanometer.

Mr. SOLOMON said that his arguments did not apply to a galvanometer of this description because the swinging system was not a magnetic needle but simply a coil.

A PAPER ON "THE DISTRIBUTION OF A GAS IN AN ELECTRIC FIELD" was read by Mr. G. W. WALKER.

The author has considered a gas as consisting of a number of molecules each containing two atoms of equal mass, one positively and the other negatively charged with electricity. When under the action of electrical forces some of the molecules split up, and we arrive eventually at a steady state in which there is a definite number of undissociated molecules and of free positive and free negative atoms. Treating the problem as one-dimensional, the potential at any point is expressed in general by elliptic functions, and is therefore periodic. Applying the results to the case of a vacuum tube it is found that there are superimposed upon the gradual fall of potential along the tube, minor periodic variations which, it is suggested, are connected with the striæ of discharge. Both the matter density and the electric density are periodic along the tube. If the places of maximum matter density coincide, with the places of minimum electrical action, then whether luminosity is due to collisions or recombinations there will be maximum luminosity at these points. In general these points do not coincide, and thus the positions of maximum luminosity are not clearly defined. The analysis leads to the conclusion that the distance between the striæ is inversely proportional to the density of the gas and to the current strength, and these facts have been experimentally verified.

MR. C. E. S. PHILLIPS exhibited a "SURFACE TENSION LECTURE EXPERIMENT."

The effects of surface tensions were exhibited by placing water between two pieces of microscope cover glass. When the glasses are circular they set in any position and one can be made to rotate upon the other. If the plates are square or elliptical they set in a definite position to which, if displaced, they immediately return. Mr. Phillips pointed out how two circular discs with liquid between could be used from which to suspend the moving system of a galvanometer.

Mr. COCHRANE suggested the use of some liquid which would evaporate less slowly than water.

Mr. BLAKESLEY asked what accuracy could be obtained with such an arrangement, and what weight it would be possible to support without squeezing out the water.

The meeting then adjourned until March 23rd.

THE COMPRESSIBILITY OF WATER.

IT is a universally accepted assumption that water is practically incompressible, but recent experiments carried out by Mr. B. H. Hite, the chemist at the West Virginia Agricultural Experiment Station, U.S.A., appear to demonstrate that this is far from being the case at pressures rising beyond those usually employed in hydraulic work.

It is found in practice that when the pressure in a hydraulic pump, for instance, rises above 2½ tons per square inch, trouble begins. Nothing seems to keep tight for any length of time, and glands and joints soon get out of order. Such pressures as 3 to 5 tons per square inch find out weak places in the body of the piping and burst them at the welds, at the joints, or sometimes at an apparently sound place, so that the hydraulic engineer's experience of the behaviour of water under pressure is limited in practice to the pressure of 2—2½ tons per square inch, which is low in comparison with those to which we are about to refer.

Mr. Hite caused a small press to be constructed with a view to determine the effect of extremely high pressures upon the bacteria which are known to exist in milk, and in the course of his investigations and researches he succeeded in submitting liquids to a pressure of over 200 tons per square inch by hydraulic power. It is clear that such a pressure cannot be maintained by the ordinary moving piston and stuffing box arrangement, nor is it likely that any system of packing can be devised that will prevent a liquid under very high pressure from forcing its way out. A method by which a pressure limited only by the strength of the surrounding material could be brought into existence is suggested by the behaviour of a bubble of gas in an ingot when under the action of the steam hammer. What pressure is thus attained could not easily be calculated. Mr. Hite has adopted a some-

what similar method. He places his liquid in a metal tube, shown by the thick black line in fig. 1. c c is a heavy steel cylinder, the lower end being closed by an accurately fitting steel plug, o, the upper end by the piston, p. Pressure is applied by a hydraulic pump.

The lead tubes are placed inside of a steel cylinder. The ram (to which is fitted a following screw for the purpose of holding the pressure) forces the lead down the bore, thus packing it completely.

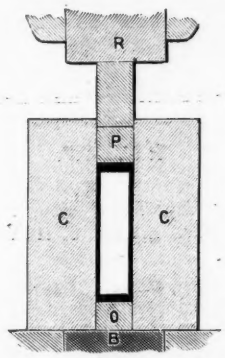


Fig. 1.

The steel cylinders used were 5 inches in diameter and 7 inches long. The bore varied from ½ inch to 1¼ inches. With such cylinders the following pressures were attainable:—

1¼	inches diameter	100,000 to 150,000	lbs. per	square inch
1	„	100,000 „ 200,000	„	„
¾	„	200,000 „ 300,000	„	„
½	„	300,000 „ 400,000	„	„

It was found that if higher pressures were used, the result was that the cylinders were permanently strained.

Most of the cylinders were made out of one piece of tool steel, but no matter how hard the steel was, the cylinder yielded more or less under high pressures, and for this reason the plug, o (fig. 1), and the lower part of the piston, p, were made of softer material, so that under the extremely high pressures, they would expand, and so fill the cylinder.

The continuous lead packing is stated to have been perfectly successful, not even so much as a trace of a leak being discerned even at the highest pressures; but on the pressure being removed, the expansion of the liquid to its original volume often loosens the lid of the lead tube, and, indeed, when very high pressures have been adopted, the liquid in regaining its original volume has pulled the lead tube in two. From this it will be readily admitted that, under such conditions of pressure as applied in this machine, liquids are by no means incompressible. It is stated that after being subjected to some of the lower pressures, a column of water originally 5 inches long was found to have been compressed half an inch or more.

Owing to the observed distention of the steel enclosing cylinder, the linear compression is not a sufficiently accurate measure of the change of length of the water column, and it must further be remembered that some allowance must be made for the distortion and compression of the lead envelope, and that the true pressure acting on the liquid is the total pressure upon the piston less the pressure upon the lead annulus surrounding the liquid; this last amount it is impossible to determine, as no one knows exactly what happens to the thickness of the lead walls when enclosing a liquid under these very big pressures.

Mr. Hite suggests the following ingenious method for determining the compressibility of liquids accurately:—

In the lead tube is placed a small picnometer bottle, the top of the stopper being expanded into a little bowl which communicates with the interior of the bottle by means of a very fine capillary hole. The bottle is accurately weighed both empty and when filled with mercury, this giving the volume of mercury necessary to fill the bottle. The mercury is then poured out, the bottle filled with the liquid whose compressibility is to be measured, the stopper inserted and a quantity of mercury poured into the bowl, which will not flow down the capillary hole because the water and mercury could not pass each other. The bottle loaded in this way is placed in the lead tube which is then filled up with water and subjected to pressure. A volume of mercury equal to that by which the liquid in the bottle is compressed will be forced down the capillary hole, and will fall to the bottom of the bottle. On the pressure being taken off a proportionate amount of the liquid will be forced out of the bottle. The amount of mercury found in the bottle when compared with the volume required to fill the bottle is a measure of the compressibility.

In this method the compressibility of the mercury is neglected. This could be determined separately or simultaneously.

Mr. Hite finds that under a pressure of 65,000 lbs. per square inch water is compressed over 10 per cent., and alcohol more than 15 per cent.

These results are certainly interesting, and it is to be hoped that before long further details of the experiments may be published.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The meeting of the Institution of Electrical Engineers on the 8th inst., was devoted to reading and discussing a paper, a reprint of which is concluded on page 504 of this issue, "On the Applications of Electricity in Medical and Surgical Practice," by Dr. H. Lewis Jones.

In declaring the paper open for discussion, Prof. S. P. Thompson, the president, humorously referring to phraseology as his own particular weakness of the flesh, twitted Dr. Jones with using the word "electrification" in a manner different to the way it is understood by electricians. Here it was employed to indicate the action of a conducting—not necessarily a charged—body. He asked the author if in the true sense of electrification, it was the slightest use to electrify a patient: for example, to place a patient in the interior of a Faraday cube and charge the cube up; the potential of the patient would be raised, but would there have been any action physiologically or pathologically, or any other "ogically?"

Mr. J. Wimshurst had been delighted to hear Dr. Jones's paper, and especially he was interested in the remarks regarding frictional or induction machines. Twenty-two years ago his attention was called to a Holtz machine in possession of Mr. Spottiswoode, and he explained to the meeting some of the disadvantages of the machine, the dangerously cut plate, and the means he had devised to get rid of these defects and other troubles in his pattern of machine. As he had a good deal of matter prepared, the President begged him to send it in for insertion in the *Journal*.

Major-General Webber said he would make a few remarks, and confine himself to one point; but his remarks became many, and his "one point" proved to be an argument as to whether the human machine is an electrical machine or not. He thought the meeting a memorable one in the annals of the industry, because probably the engineer and the physiologist had not met before. He asked whether the word stimulus, as employed in the paper, indicated that the Doctor meant that electricity is only a stimulus to the animal frame? Every telegraphist must have been delighted by the description of the means of electrically testing the nerves, as telegraph engineers have so much to do with fault-finding by means almost identical with those the lecturer described as employed for locating the troubles in the nerve system. He asked if there were not something within the human frame analogous to the generation, distribution, and utilisation of energy. This point was elucidated by comparing statements by Helmholtz, Michael Foster, and others as to the work the heart can do and the electrical actions connected with the heart's action. He believed that anything which brings the engineer and the physiologist together, or nearer, must be of use to the Institution and to fellow-creatures.

Mr. F. J. Mudford thought that Dr. Lewis Jones would find a set-over pointer milliampere-meter a useful instrument, while Sir Henry Mance referred to some tests he had taken years ago of the resistance of the human body from one wrist to the other, and he mentioned the trouble polarisation gave in the experiments. The figures obtained for white subjects (presumably the tests were taken in the East) were considerably lower than those for black subjects—a matter afterwards explained by Dr. Lewis Jones as very probably being due to the greater liability of Europeans to perspire and to have the pores of the skin open, and the surface moist in a hot climate than would be the case with natives.

Prof. J. Perry spoke "as a Philistine." He considered that such a paper was another argument against the great evil of earthing the return wiring of ships and houses. He suggested that small accumulators should be charged in series with an incandescent lamp—the lamp being chosen to give the proper charging current.* He then turned to the line of thought suggested by Major-General Webber, and indicated that the human body can't be a heat engine. The temperature was 40 times higher than it would be by the second law of thermo-dynamics were it a heat engine. He hazarded the opinion that it was a gas battery. Last year at Baden-Baden he became acquainted with a medical man who, for 20 years

* We believe this is the common method of charging small cells.—Eds. Elec. Rev.

had been making experiments on atmospheric electricity, and he was able to predict 15 hours beforehand the certain kind of patients who would come in crowds to see him as the result of an atmospheric change.

Mr. W. H. Coffin criticised the relations between the physician and the physicist. Neither of these had met in the physiologist. He referred to the paper read 15 years ago before the Society on medical electricity, when Mr. W. H. Preece (as he then was) severely handled the M.Ds. as being completely ignorant of what a volt, &c., might be. The speaker thought that there would always be a difference between electrical and drug measurements, and as Dr. Lewis Jones stated in his paper, in the modern use of electricity there is a greater tendency towards general rather than local electrification. The great drawback to measurement was the imperfect knowledge possessed of the conducting power of the skin. We do not know what is really being done when a certain current is applied to a patient. Dr. Lewis Jones had given in his paper an encomium of the electrical water bath, but the difficulty was, one did not really know the current the patient actually received and had. One was led to consider it was a cutaneous effect, and not a very deep one. We have never been able to invert the process and say what effect electrical charges had upon metabolic changes.

Capt. W. P. Brett asked if X ray work was found to have any curative effects. For charging small cells some difficulty had occurred in the Egyptian campaign until a combination of tandem bicycle and small dynamo was thought of, which worked well enough.

Mr. Mordey recommended thermopiles for charging small cells, and mentioned the Cox thermopile, which gave an ampere or two at a few volts. He lamented the fact that electro-medical apparatus was so badly designed, and recommended engineers with spare time to take up some of the points in design of such apparatus. The ordinary medical coil was a very feeble thing in this respect, and it had lasted long enough in its present form. In one of the coils exhibited by the author, nicely polished as its case was, the core was short circuited by a solid piece of metal, and it had the long straight form which everyone knew was not the most efficient.

Mr. A. P. Trotter cited aluminium "one-way" cells as possibilities for rectifying an alternating current for small cell charging. He wanted to know the quantity Dr. Lewis Jones was anxious to measure; was it milliamperes or millicoulombs, or what? He had studied the work of the author for 20 years, and he eulogised what had been done. He referred to the fact that if the arm were held out horizontally no engineering or mechanical work was done, but he believed that physiologically work was done. Now the painful or tired feeling was wiped out by a current, and an application of electricity might perhaps be used to wipe out some of the tiredness at the end of a day's work.

Dr. H. Lewis Jones, in his reply, stated he had tried to be as careful as he could to use the proper terms, and he amused the meeting by lifting the veil from the everyday practice of medical men who sent patients to him "to be galvanised," "to be electrified," and so on. It was, he said, one of the daily efforts of his life to avoid, and try to get others to avoid, the word "Faradisation," but that and "Franklinisation" were often found in medical works, while recently in a French paper he came across "D'Arsonvalisation," which he thought was coming it a little too much. He said that Gen. Webber and certain others of the speakers had, in their remarks, practically raised the question, "Is electricity related to vital force? Is a nerve impulse an electrical impulse?" Whenever a chemical change takes place we know there is an electrical action, but whether in the body these actions are mere waste or are of great importance he could not say. There was no immediate or superficial connection, and to go deeper was to encounter difficulties the author would rather not go into that evening. He did not feel himself qualified to tackle the subject suggested by Prof. Perry. As to X rays, there was no doubt that they have a therapeutic value. On the question of thermopiles, the life of the apparatus and price were considerations. Most electro-medical apparatus came from Germany, as there the manufacture was done in a large way. A medical man wanted cheap apparatus, as he could not afford out of his own pocket to spend much money on it. He had tried to make the aluminium cell work, but although he had given a lot of time it had not turned out well. Mr. Trotter had cited a most interesting thing, and in a new paper by an Italian it was shown that electrical stimulation increased muscular force, and the increase lasted a day or two after the application. He gave a few general remarks on the quantity which really should be measured in the case of the induction coil discharge, and the discussion then closed.

There was a general feeling that the paper had hardly received its proper amount of attention from the medical fraternity, but had been much appreciated by the engineers.

REVIEW.

An Introduction to the Study of Central Station Electricity Supply. By Albert Gay and C. H. Yeaman. London: Whittaker & Co.

When two gentlemen, engaged in practical work, put their heads together and reduce to print a chatty description of the problems which are constantly confronting them in the daily routine of their work, and in the development of the undertaking under their charge, they are likely to produce an interesting book, and without doubt Messrs Gay and Yeaman have fully succeeded in doing so.

Interesting, however, as the book may be as a reminder of these problems, it is a little difficult to decide for whom it has been written.

Obviously it is not intended for engineers, as the information contained throughout is of a somewhat rudimentary nature.

Possibly it may be intended for the edification of that large and increasing class, the members of town councils and vestries, who may be seriously anxious to know something of the *pros* and *cons* that affect the various problems connected with the generation and distribution of electrical energy.

It will also prove useful to the growing band of young gentlemen, whose fondest aunts hardly dare dub them "Engineers," but who, as soon as they have attained the grade of A.I.E.E, consider themselves capable of saving a town council the consulting engineer's 5 per cent. by "doing the work themselves."

We can imagine from the style in which the book is written that it is the function of, at all events, one of the writers to receive deputations from other municipal bodies, and to settle them down to a lecture.

There is a flowing dogmatic style in some of the pages that makes one think one can hear the clock tick as the sonorous sentences, between the puffs of a cigarette, are rolled off.

To give an example, page 317 :—

> Nor must it be forgotten that after all distribution is the alpha and omega of electricity supply, for to it is due the creation of "systems," the divergence between practice in one place and that in another, and the host of technical questions that go to make up the business itself, although, as has been shown, financial results are only slightly affected.
>
> Theoretical conditions cannot be directly applied to feeders and feeding points any more than they can to the other business of the central station engineer. If all the data could be asked for and obtained from the public at the time of preparing designs, the hit-and-miss principle might be ignored, but, unfortunately, precise information respecting loads and demand *are* (*sic*) always conspicuous by their absence just when most wanted, and this is so very pronounced at the time of settling the runs of conductors that the more prosaic course of doing what seems the best thing, and guarding against the mischance of after events proving it to be otherwise, by an ample number of junction and connecting boxes, is what really gives the best results in the long run.

Of course, when one has previous knowledge of the subject, the solution of the enigmas concealed in the above sentences presents no great difficulty, but we can imagine their effect on the deputation from, say, Stoke Pogis to the Islington Works, and we can hear the applauding exclamation of "Prodigious" from its chairman.

By-the-bye, is it true that to *distribution* is due the creation of systems? We were under the impression that the leading members of the Institution of Electrical Engineers had arrived at a consensus of opinion that by the word "distribution" should be designated distribution to

consumers, and in perusing this work we gathered from pages 117 and 118 that the authors were sound upon this point.

Obviously, in the accepted interpretation of the words "distributors" and "distribution," the latter is unaffected by "systems" of generation. The divergencies between low pressure and high pressure, and those between continuous and alternating systems, may show themselves in methods of "feeding;" but the 250 volts supply, distributed to the consumers under the Board of Trade regulations, may be given to them quite irrespective of the "systems" employed. In this book, however, "feeding" and "distributing" are regarded as synonymous terms. Too great exactitude should perhaps not be demanded from two such practical gentlemen as the authors. It only needs the turning over the page to obtain another illustration:—

The feeders, however, are not directly revenue earning, and any unnecessary increase of capital expenditure in this direction tells against the capital cost, the upkeep cost, and the load-loss cost. Also it may be impossible to efficiently utilise the system of supply (say, direct supply without conversion), which is otherwise most suitable for the district should the generating centre be removed to a distance from the consumption area, and consequently a less desirable method may have to be used to enable supply to be given at all.

All locations are equally suitable, from a distribution standpoint, that are the same distance from the best position of the station, supposing the consumption uniform throughout a symmetrical district. Although the problem is readily amenable to mathematical treatment, little can be gained by such an investigation, as the engineer has to meet the conditions he finds in practice, and cannot create such as would enable him to utilise his theoretical deductions.

It is difficult to postulate the conditions which are beyond the utilisation of "theoretical" deductions, but still more to conceive feeders which are at the same time unnecessarily large, and which involve an increase of "load-loss cost."

"Theoretical deductions" would have led one to conclude that an excess of copper in the feeders by the application of the $C^2 \times R$ rule would have lessened instead of increased the "load-loss" cost.

To those, however, who do not look to the book to teach them overmuch it will certainly prove useful, and doubtless the authors, having launched it forth, will now quietly settle down to rewrite the more obscure portions and to expunge those deductions which do not fit in with theory.

On almost all aspects of electricity supply the authors have delivered themselves dispassionately and without bias, but on one point they have allowed their predilections to carry them away. They have on their hands the working and development of an alternating high pressure system, and they state on page 184 that

A reasonable difference in magnetising power is of extremely little moment and can hardly affect the works or total costs one way or the other.

This opinion is not shared by us or by the leading electrical engineers of the day. It is quite true that there are districts which could not be supplied at all, from one station, on commercial lines, except by a "converted system of supply," and the cost of generation of the magnetising watts must be cheerfully borne as the price to be paid for the advantages accruing to centralisation of generation.

Our authors, however, make no such concession, and state that energy when used for magnetising can be generated for a negligible cost, their argument being that

In all stations a reasonable (*sic*) sized unit of plant must be run during the day to comply with the obligation to maintain a constant supply

and therefore, that an extra 50 or 100 KW. of magnetising watts can be given off simply for a pinch more coal, and without the slightest addition to the remaining charges.

Of course, if the addition of magnetising watts causes the "useful" plant to be overloaded, and necessitates the running up of an additional set of plant, then the ingenious theory set forth by Messrs. Gay and Yeaman at once falls to the ground.

Has it never struck them, however, that in the total cost of generation must be included the wear and tear of the generators as well as the interest on the capital locked up therein, and that such costs must be borne alike by all units generated, whether they be supplied to the paying consumer, to the bankrupt one, or to the prodigal one named "Magnetising Watts"?

To those who think this doctrine hard, we commend a comparison of the cost of working of the undertakings in London supplying on the rival systems. The Islington alternating current undertaking, with the enormous advantage of a heavy all night load, would surely not be eclipsed by the low pressure undertaking at, say, Notting Hill, if it were not for the heavy addition to its costs caused by the generation of wasteful magnetising watts! Nor, to take a case outside London, would the costs at Coventry exceed by almost twopence per unit, those of works with almost identical output at Dewsbury.

THE POLLAK-VIRÁG SYSTEM OF TELEGRAPHY.

By CHAS. H. GARLAND.

(*Continued from page* 429.)

The telephone membrane of the receiver is thrown into movement by the currents which are sent out by the sending apparatus, and according to their direction either approaches or recedes from the electro-magnet. By means of a tiny rod the movement of the membrane is communicated to a small concave mirror, shown in fig. 4. As the vibration of

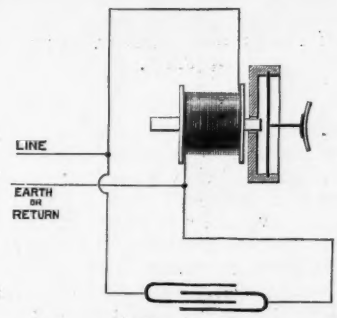


Fig. 4.

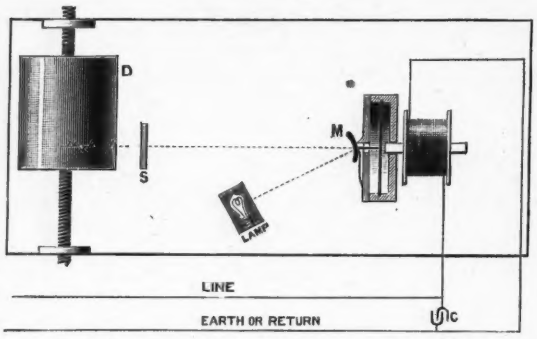
the membrane is exceedingly small, it is necessary that there should be some method of magnification of the movement in order that it should make an appreciable alteration in the direction of the reflected ray. The inventors have surmounted this difficulty in a most ingenious manner. On the back of the mirror is fixed a tiny soft iron plate, and by this means it is held fast to one pole of a permanent magnet. This pole of the magnet terminates in two small points, and the connecting line of these two points forms the axis of movement of the mirror. The second pole of the permanent magnet is connected with a weak spring which also ends in a point. This point forms a third attachment for the mirror. The spring in its turn is connected with the telephone membrane by a small rod by which movements are communicated to it. As the points of attachment of the mirror lie very close together, the movements communicated from the membrane are considerably increased, whilst the method of attachment reduces friction to a minimum.

The light of a small glow-lamp falls on the concave mirror and is reflected on to a drum covered with sensitised paper. Before the sensitised paper a lens is fixed which concentrates the reflected rays to a point. This point of light is moved upward or downward according to the movement of the mirror, and thus writes a line upon the sensitised paper which rises or falls in sympathy with the currents sent out from the sending station. The sensitised paper is stretched on a drum which, in addition to its revolution, moves also in the direction of its axis. This movement is so regulated that the drum in each revolution moves a sufficient distance to allow the line of signals of the following revolution to be printed clear of the first line and so on until the whole of the paper is full.

This apparatus would not in practice give good results unless many other difficulties had been surmounted. For instance, the telephone membrane, in addition to its movements in response to the currents sent into the line by the transmitter, has a proper movement of its own. The vibration of the membrane is really a combination of its own proper or self-vibration, and the vibrations impressed upon it by

the electro-magnet. It was necessary to eliminate the proper vibration of the membrane. The ordinary methods of damping were found to be unsuitable, and a special method was devised by the inventors.

This "damping" method is an essential part of the system. If we send into the telephone a current of long duration the membrane is thrown out of its position of rest to a degree proportional to the strength of the disturbing current. It then springs back towards its original resting position, or even a little beyond, and continues to vibrate in



M, Mirror; D, Drum of sensitised paper; S, Lens; C, Conductor.

Fig. 5.

movements of decreasing amplitude until it finally comes to rest in its new position. If a very brief current is sent into the telephone, the membrane vibrates in response to this current, and then vibrates in movements of gradually decreasing amplitude until it eventually comes to rest. If, however, the duration of the current be exactly the time occupied by a single vibration of the membrane, if the current cease at the exact moment that the membrane in its movement reaches its normal resting position, then there will be no further movement, as the energy necessary to produce the vibration will have ceased. The minute movements then made are insufficient to effect the quality of the marks. The inventors have made the duration of their currents correspond exactly with the vibration period of the membrane. By the exact adjustment of the position of the perforations in the sending ribbon and the speed of its movement, the duration of the currents sent out regulates the "damping" of the membrane and extinguishes, or avoids, the disturbances which affect the clearness of the marks.

In order that this very delicate adjustment shall not be so essential as to render working impossible without it, a further means of overcoming the difficulty has been devised. The time duration of the current is made shorter than the vibration period of the membrane and a condenser (see fig. 4) is inserted parallel to the telephone. The condenser is charged during the duration of the current and discharged when the current is broken. This discharge prolongs the fresh current and limits the vibrating period of the membrane. The result of this ingenious arrangement has been the perfection of the marks.

There were still other difficulties to be overcome before it was possible to send messages over a lengthy line. A long line has generally a high resistance, great capacity, and still greater self-induction. As a result a current loses much of its original character before reaching the distant receiving station. If the break of the current at the receiving station is not sharp, but the current disappears only gradually, the marks are rendered unreadable. It is obvious that the resistance, capacity, and self-induction of a wire are hindrances to rapid telegraphing. A self-induction coil (see fig. 3) is therefore inserted in parallel at the sending station, and the dimensions of this coil correspond with the disturbing factors of the line. When a current is sent to line a portion of it goes into the self-induction coil. At the moment the current is broken a current of similar direction arises in the coil. This latter current will, however, flow in the opposite direction in the line, and will neutralise the hindering results arising from the flow of the first current through the line.

The first experiments were carried out on an artificial line, with a resistance of 2,000 ohms, and a capacity of 8 to 9 microfarads. The results were so satisfactory, that it was determined to test the invention on a working line. At the request of the United Electrical Company, of Buda-Pesth, the State allowed four lines from the central office to be connected with the laboratory of the firm. These were joined during the night to four lines running from Buda-Pesth to Temesvár. Both the sending and receiving apparatus were placed in the laboratory, but the current had to pass over a double line of 650 kilometres of 4 mm. copper wire. The resistance of the line was 4,000 ohms. The experiments were first carried out during fine dry weather, and later in very wet weather. In both cases good clear marks were obtained, with a speed of 70,000 words per hour. For this a pressure of 20 volts was found necessary, whilst with 25 volts 100,000 words were sent. Even with the high speed the limit of the speed of the apparatus was not reached.

The experiments carried out on a double iron wire, 340 kilometres in length, with a resistance of 6,000 ohms, despite strong self-induction, gave a speed of 54,000 words per hour, with a current of 60 volts.

The sending was arranged in such a manner that a perforated slip was placed on a drum and again and again telegraphed. The induction of the neighbouring wires has not seriously affected the marks. The effects of the induction of neighbouring wires can be eliminated by adjusting the distance of the magnet core from the membrane in the receiving apparatus. The regulation is very simple.

Fig. 5 is a schematic representation of the whole of the receiving apparatus. Fig. 6 is a photographic reproduction of a message received over a line 650 kilometres in length at the speed of 100,000 words per hour. In the position in which it appears on the page it is necessary to read the upper waves as dots and the lower waves as dashes. Fig. 7 shows

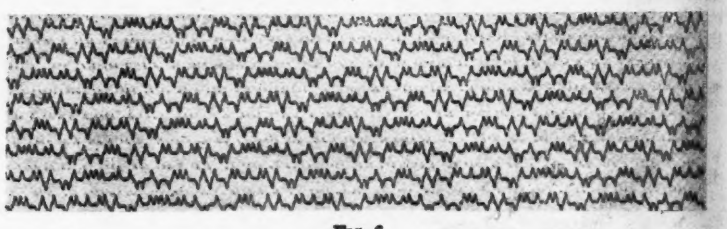


Fig. 6.

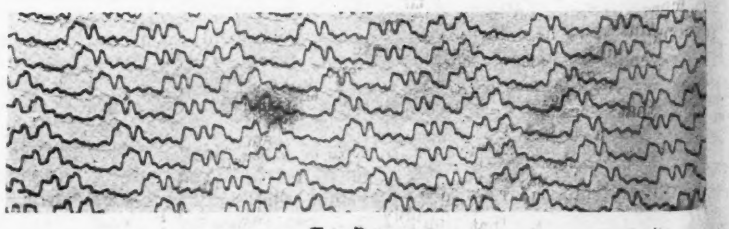


Fig. 7.

a message received when for a second the corrections were cut out, and demonstrates the effect of the disturbance caused by the line faults and the proper vibrations of the membrane. In actual practice a message of 500 words occupied 22 seconds in transmission, the fixing of the marks and other preparation for transcription occupied 2½ minutes.*

The telegraphing of a daily paper of 16 pages, containing

* Writing under date of March 6th, Herr Pollak says:—"We are now working with endless slips and diagonal writing, combined with an automatic system of development, so that messages are ready for transcription immediately on receipt."

40,000 words, by this system would take 25 minutes, whilst the Hughes system would take 30 hours, and the Morse about five days, working day and night.* Such a system could materially reduce the cost of telegrams by reducing the number of trunk lines.

There are many little economies which are effected in other ways. A message of 500 words received by the Pollak-Virág system occupies a piece of paper measuring 65 centimetres by 9 centimetres. The same message would require 70 metres of Morse slip, according to the Austrian estimate. Half that length is nearer the English estimate.

Under any conditions where high speed telegraphy is an advantage the Pollak-Virág system should have a great future before it; where the number of trunk lines is limited its advantages are unquestionable. We shall await with interest the results of its application to cable working, which should certainly receive the attention of the inventors.

AMERICAN SLIMNESS.

An editorial to which, for American readers, our New York namesake gives the title "The Opportunity," would doubtless be rechristened by English readers "Friends yet Foes," or "What's the use of a Friend if you can't take advantage of him?" The article advocates pushing American commerce at all costs, and selects the present moment as furnishing a most excellent opportunity for taking advantage of the pre-occupied position of this and other countries. The comments savour very much of the counsel of the venerable quaker to his youthful disciple on money-making. The writer, who classes himself with students of social and political affairs, says he sees "in the present conditions which surround the greater part of the world a marvellous opportunity for American commerce which will not likely be repeated." We quote further:—

"Great Britain, our closest friend ['Save us from our friends!'] and bitterest trade rival, is engaged in a war which has withdrawn from its territory a large number of men comprising a highly active industrial element. It is also in the throes of an industrial revolution, having wakened to the fact that its methods of manufacture must soon be reorganised, unless its prestige as an export country is to disappear."

It is something to find our military forces spoken of so appreciatively as "a highly active industrial element," while Continental critics class them as the residuum for whom we cannot find employment in the ordinary occupations. But this is a digression, and we quote again:—

"France, though rent by political strife, is to hold this year its great exposition, and to put forward its best efforts to retain some of the manufacturing industry which is slipping away from it. The German Empire is making herculean efforts to gather for itself the fruits of the situation, but it is hampered beyond ordinary understanding by the existence of its military system, and also in great measure by the hostility of other countries toward it. The Italian peninsula is waking from a sleep of centuries under its present stable and popular government, and is welcoming the importation of new ideas, new methods, and new machinery for the development of its natural riches. Russia cannot be a manufacturing country for many decades, but its enormous population and vast extent present a great market for all manners of goods. In the East the acquisition of the Philippine Islands has focussed the attention of the world upon that region, while the policy of England and the United States in China is such as to invite at once the widest extension of trade."

Having thus taken so gloomy a view of the present outlook for other countries, our contemporary dilates in the following belated style upon the very rosy aspect that events bear for American commerce, as though the elements had been working together to promote the prosperity of Brother Jonathan, our "closest friend and bitterest trade rival," at the expense of everybody else:—

"Hence, the time has come for American manufacturers to take the same position as a factor in the world's supply that has been held by their agricultural brethren for many years. This country is blessed with an enormous and increasing prosperity. It is at peace and likely to remain at peace with all its neighbours. It has every advantage of climate, resource, and skilful population to put it in the first rank of manufacturing countries and keep it there. The rest of the world is its market. These few facts are things that no American maker of any goods that are used by any people on the face of the earth should ever forget."

Your hand! brave friend. Press on to conquest
O'er Afric's rash marauders.
You win the glory, we the prize;
We'll coolly take your orders!

Our American friends know from experience over the Venezuelan affair that British friendship pays, but the spirit displayed in the above comments quoted from the *Electrical Review* of New York is but a poor return for the support which we gave our cousins in the Spanish-American war.

* This is the Austrian estimate.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this Journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

4,157. "Improvement in electric accumulator traction." B. M. Drake and J. M. Gorham. Dated March 5th.

4,168. "Improvements and devices for rapidly transmitting impulses of current." L. Cerebotani and A. Silbermann. Dated March 5th. (Complete.)

4,190. "Improvements in solution for galvanic batteries." L. Boulard. Dated March 5th.

4,193. "Improvements in signalling devices for telephone systems." P. M. Justice. (H. M. Williams, United States.) Dated March 5th. (Complete.)

4,198. "A new or improved time apparatus for making and breaking telephonic and telegraphic circuits." R. de Lamprecht. Dated March 5th.

4,230. "Improvements in electric gas lighters." H. D. Fitzpatrick. (C. Hubert, United States.) Dated March 6th. (Complete.)

4,236. "Improvements in filaments for incandescent electric lamps." T. A. Rose. Dated March 6th.

4,248. "Improvements in switches or circuit-breakers for high potential electric circuits." The British Thomson-Houston Co., Ltd. (E. W. Rice, Jun., United States.) Dated March 6th. (Complete.)

4,262. "Improvements in storage batteries, and in the method of making electrodes therefor." P. A. Newton. (The Knickerbocker Trust Company, United States.) Dated March 6th. (Complete.)

4,268. "Improvments in tools for use in the laying of tile conduits for electrical conductors." H. H. Lake. (American Vitrified Conduit Company, United States.) Dated March 6th. (Complete.)

4,287. "Improvements in telephonic intercommunication systems." W. Aitken. Dated March 6th.

4,358. Improvements in electric bell pushes." H. C. Swindell. Dated March 7th.

4,365. "Improvements in translucent reflectors for incandescent electric lamps." D. Shoolbred. Dated March 7th. (Complete.)

4,369. "Improved couplings for electrical connections." J. J. Rawlings and W. R. Rawlings. Dated March 7th. (Complete.)

4,376. "Improvements relating to the electrolytic production of metal bars for the manufacture of wire." E. Emerson. Dated March 7th.

4,383. "Improvements in $\frac{\text{and}}{\text{or}}$ connected with electric controlling apparatus." J. C. Lincoln. Dated March 7th. (Complete.)

4,387. "Improvements relating to systems of alternating current electrical distribution." C. I. Young. Dated March 7th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, August 8th, 1899, being date of application in United States.)

4,390. "Improvements in electrical switches." Veritys, Limited, and R. H. Rogers. Dated March 7th.

4,408. "Improvements in and relating to electric fittings." J. Dewar. Dated March 8th.

4,457. "Improvements in door locks operated by electricity for engaging and disengaging bolts." W. Schade. Dated March 8th. (Complete.)

4,461. "Improvements in or relating to electric cables or conductors." W. J. Glover. Dated March 8th.

4,472. "Improvements in electric motors." A. M. E. Berthier. Dated March 9th.

4,489. "Improvements in primary batteries." A. M. Young. Dated March 9th.

4,500. "A new or improved self-locking elbow joint for electrical fittings." H. Hirst and J. H. Collings. Dated March 9th.

4,508. "Improvements in electric signalling systems for railways." M. Garl. Dated March 9th. (Complete.)

4,509. "Improvements in electric traction." E. H. Tyler. Dated March 9th.

4,527. "Improvements in multiple-contact telephone transmitters and circuits relating thereto." C. Adams-Randall. Dated March 9th.

4,528. "Improvements in electric telephony." C. Adams-Randall. Dated March 9th.

4,555. "Improvements in or connected with electric distribution." J. G. Lorrain. (F. Bedell, United States.) Dated March 9th.

4,557. "Improvements in the distribution of electric current and apparatus therefor." W. P. Thompson. (J. Dulait and O. Garbe, Belgium.) Dated March 9th.

4,561. "Improvements in or connected with electric trolleys and other electrically conducting mechanical parts." A. F. Cothias. Dated March 9th. (Complete.)

4,570. "Improvements in overhead travelling electric cranes." W. H. Vaughan and T. Foster. Dated March 10th.

4,586. "Improvements in telegraph receivers." L. Cerebotani and A. Silbermann. Dated March 10th. (Complete.)

4,591. "Improvements in electricity meters or measuring apparatus." P. Warwick-Davies. Dated March 10th.

4,607. "Improvements in electrical gas lighters." H. von Arnswaldt. Dated March 10th. (Complete).

4,617. "Improvements in applying electric currents to electric lighting." H. F. K. Picard. Dated March 10th.

4,622. "Improvements in and mechanism for reversing electromotors." A. Reichwald. (The firm of F. Krupp, Germany). Dated March 10th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

15,099. "Improvements in or relating to apparatus for controlling and governing electric motors." R. Belfield. (H. P. Davis.) Dated June 23rd, 1897. Apparatus for controlling compound or shunt-wound motors, particularly those employed for operating elevators and hoists, comprises a starting, stopping, and reversing switch, and a magnetically-operated resistance switch. The starting, stopping, and reversing switch consists of a rotary drum carrying six contact-strips upon which bear four fixed contacts and two contact-strips upon which bear two fixed contacts. The movable contacts are arranged and cross-connected; the fixed contacts are in connection with the motor armature, the shunt field winding, the resistance switch, and the supply conductors. The resistance switch comprises a resistance column, the several sections of which are connected to two series of contacts, over which travels a contact-brush carried by an arrangement of bell-crank levers operated by the core of a solenoid provided with a dash-pot so as to automatically and gradually short-circuit the resistance after the motor circuit is completed. In the regulating-switch, the fixed contacts or brushes bridge the spaces between the contact-strips during the process of reversal, so that the circuit is not broken. The formation of an arc between the contacts is prevented by a pair of electro-magnets excited by the coils. The brushes for the armature contacts may be constructed in two parts connected together by a resistance. 5 claims.

16,918. "Means in connection with cycles for generating electricity." P. Wagner. Dated July 17th, 1897. A dynamo mounted on a cycle is driven by means of a cord passing over a pulley in frictional contact with the rim of one of the wheels. In another form the driving cord passes round a grooved lateral extension of the wheel and rim. An accumulator and electric lamp are employed in connection with the dynamo. 2 claims.

19,424. "Electrical glow light." W. Nernst. Dated August 23rd, 1897. A body of magnesia, zirconia, or suitable rare oxide, sulphide, fluoride, silicate, or other non-conductor is heated to incandescence by a Bunsen gas flame or otherwise, and is then kept incandescent by the passage of electric current through it, using a pressure of 100 volts or more, as desired. The flame may be retained or removed after starting. The incandescent body may be a rod held between metal springs, and is preferably unenclosed. The lamp is stated to be as efficient as an arc lamp as regards the proportion of electrical energy emitted as light. The provisional specification describes the use of a tubular body, the preliminary heating being effected by passing a spark-discharge through it. 3 claims.

19,567. "Improvements in or relating to converter chambers and their connections and to fuse and switch apparatus for use therewith." G. W. Partridge and London Electric Supply Corporation. Dated August 24th, 1897. Relates to transformers provided with high and low tension connection compartments, and also to fuses and switches for use therewith. The chamber consists of a metal box, preferably cylindrical in shape, and provided at the top with an extension divided by a partition into two compartments for the connections. The first compartment serves for high tension connections. At the opposite sides are arranged two stuffing boxes, the former serving for the passage of two concentric high tension leads. The inner lead or conductor is coupled to a conductor passing through the second stuffing box, and connected to one end of the transformer. The outer conductor fits into a casting having a detachable cap, and is connected by a conductor with a bolt passing through, but insulated from, one of the sides of the box. A conductor connects this with the transformer. The low-tension leads are coupled in the department. Each conductor is fitted with a tapering plug fitting in a correspondingly-shaped hole in a metal bearing fixed by a suitable nut. The bearings are connected by fuses. The chambers are fitted with movable covers, that for the transformer chamber having a flanged opening surmounted by a cap. A box is fitted with sockets or carriers, and with boxes or branches which serve for the passage of the ends of the two conductors in the first stuffing box. Each socket supports a holder fitted with connecting-device having spring fingers. The fuse consists of one or more wires supported in a porcelain block fitted with contacts, adapted to engage the spring fingers. The fuse device can thus be used as a switch. The outer conductors are connected by the wire. 4 claims.

19,573. "Improved means for supplying current to electric tramcars." A. Sowden. Dated August 25th, 1897. Relates firstly to improvements on the mechanically operated, and inter-connected switches described in Specifications No. 14,647, A.D., 1893, and No. 13,549, A.D., 1894, and secondly, to supports for conductors on the conduit system, and to collectors used therewith. Instead of the arrangement shown in Specification 13,549 of 1894, a spring is used to pull over the levers, to both of which it is connected, and their friction bowls run between the cams and the straps. According to the second part of the invention the conductor is held by hinged claws, or a clip on a support which is carried by insulated wires or by an insulated rail placed across the conduit. The wires are tightened by a screw coupling. The collecting-arm is depressed by a spring. 3 claims.

19,714. "Improvements in and connected with electric traction." E. Bede. Dated August 26th, 1897. Relates to electric railways and tramways on a road contact system with mechanically operated switches. Plugs normally held out of contact with the main conductor by a block of rubber are caused to touch it by the pressure of the collector. In one form the contacts consist of a plate attached to the conductor and a spring carried by the plug. A short tube is attached to the lead casing of the conductor to enclose these parts or a cast-iron box in two parts is used, which also shows the contact clamped on the cable. These contact boxes may be disposed horizontally or with a downward inclination within a shallow trough or conduit placed inside, outside, or against the rails which then form part of the conduit. Two sets of boxes may be used one serving for the return. The conductor may be laid on concrete blocks bolted to the rails or not and surmounted by wooden stringers to which are attached angle-plates for protecting the slot of the conduit. The boxes may be partly filled with and surrounded by insulating material. For collectors, jointed bands formed of sections of leather, wood, &c., are covered with metal plates on both sides. Renewable copper plates are attached to the plates on the sides facing the boxes, and the sections are weighted by iron blocks hinged together so that the collectors can follow curves and inclines in the conduit. In a modification the collector is made as an endless belt supported on pulleys. 4 claims.

19,745. "Improved electro-magnetic picking mechanism for looms." W. Fairweather. (F. E. Klein). Dated August 27th, 1897. The shuttle contains an electro-magnet and a series of electro-magnets are arranged beneath the shuttle race. Suitable contacts and circuits are arranged so that the shuttle acts as the armature of a motor and the magnets under the shuttle as field magnets or *vice versâ*. Arrangements are described for continuous and for alternating currents. If a three-phase current is employed, a short-circuited armature is placed in the shuttle and the contacts are dispensed with. In one arrangement the shuttle is grooved to pass over pins which guide it and form contacts. Dents of the reed which are opposite the pins, have enlargements to prevent the warps from catching on the pins when the shed is being formed. When dressed or twisted warps are used it is sufficient to round off the tops of the pins. In weaving wire fabrics the sides of the pins are covered with insulating material. Cam pieces at each end of the lag actuate a commutator in the shuttle to reverse the circuit through the magnet for each right or left hand throw. In weaving with a single shuttle, the magnets may be extended as far as the position of rest of the shuttle at each end. This arrangement is, however, inapplicable in connection with a change box mechanism, so another device has been designed in which the energy of the incoming shuttle is stored in the spring and utilised to start the shuttle again. The spring is held in a state of compression by a trigger, released by the withdrawal of the bar from beneath a lever. The shuttle is kept in contact with the buffer on the end of the spindle by a spring catch which is released as soon as the spring has moved the shuttle through a short distance. 4 claims.

19,794. "Improvements in electric arc lamps." W. J. Davy and T. Davies. Dated August 27th, 1897. Relates to arc lamps with enclosed arcs for continuous or alternating currents. The frame of a lamp consists of a loop connected to an outer casing and an insulator which is secured in a tube. This tube and an outer tube are attached to a small casing containing the clutch; two rods on the small casing carry an elliptical ring at the bottom. The upper end of the outer tube is closed by a spring-pressed cap. A bell glass is mounted with the lower carbon holder on a stem which rests on a spring in a socket screwed into a cross bar. The cross bar rests in notches in the elliptical ring, through which the bell and other parts may be lowered after partially unscrewing the said socket. The socket spring holds the bell against a packing ring on a conical plate. An outer globe is supported under the outer casing by a nut on a screw depending from the socket. The upper carbon is inserted in a holder sliding in the tube and passes through clutch devices similar to those described in Specification 5,474, 1894, consisting of two rollers carried by two pairs of links. The links are jointed at their inner ends to pins which slide vertically in guides or rest on the conical plate. The outer ends of the links are connected by four cords through two sleeves to a tubular core, which may be made up of strips and slides between the two tubes, attached to the casing containing the clutch into a series coil. The core is linked to a piston sliding in the closed end of the inner tube and on a stationary plunger. The upper carbon holder is connected by a flexible conductor to one of the links on the core. The series coil is wound between cheeks on the outer tube and enclosed in iron strips to increase its impedance. An additional resistance is mounted at the top of the lamp. 7 claims.

25,151. "An improved system of automatic telephone exchange." M. Margowski. Dated October 29th, 1897. Automatic telephone systems are arranged in double multiple board form, one set of boards being termed the "linker" boards and the other set being the "catcher on" boards. Each board is provided with a "service" wire for each subscriber, besides the "line" wires represented on the board; for convenience, one pair of "line" wires is provided with the "linker" service wire on one side and a "catcher on" service wire on the other side. These sets of four wires are arranged in groups of five, and each group is separated by a space. Before each board sets of "linkers" and "catchers on" are arranged, and are connected together so that each "linker" of a board is connected to a "catcher on" at another board. A subscriber in calling then has to compose his signal, *i.e.*, set his selecting apparatus, in such a way that the sequence of signal currents sent shall operate the exchange distributing and selecting mechanism so as to place him in connection with the necessary "linker" and "catcher on" operating mechanism, and shall then operate those mechanisms so as to select his own and the called subscriber's wires. At the completion of the signal all the exchange selecting mechanisms is returned to its normal position, and the connection between the subscribers is left complete, the calling signal being sent automatically if the called subscriber's line tests free. Should, however, the line of the subscriber wanted test "engaged," the calling subscriber is notified, and the final signal current restores all the connections to their position of rest. The circuits are so arranged that the exchange selecting apparatus is only occupied by a subscriber during the time of calling, and is then freed immediately that the signal is completed. Twin "catchers on" are also described, in which the duplicate or twin portion can be operated although the first portion is still in use. 17 claims.

25,183. "Improvements in and relating to brackets, chandeliers, electroliers, and the like." C. Darrah and T. Gibson. Dated October 30th, 1897. Lamp brackets and the arms and branches of electroliers, gasoliers, and the like are constructed of flexible metallic tubing, so stiffened that they may be easily bent or turned to any desired position, which they will retain as long as desired without the employment of swivel or other joints. In a modification the flexible metallic tubing is stiffened by a copper or other strip, but a clip or short length of rigid tube or the like may be adapted to slide upon and retain the flexible tubing. The latter may, however, be lined with a tube of thin soft copper, through which the gas or the electric wires are conveyed to the lights or burners. 1 claim.

25,400. "Improved electrolytic process and apparatus for the separation of metals from their ores and solutions." E. Metz and H. F. Welch. Dated November 2nd, 1897. Relates to obtaining metals, such as gold, from their ores. The ores are crushed, mixed with a suitable electrolyte, and passed down through an inclined electrolytic tank forming a kind of sluice. This tank consists of independent removable sections, each suitable for one man to lift, which are connected together by battens while the joint is made secure by pouring asphalt or the like into adjoining grooves in the sides and bottom of each section. Each section is built up of sides and a bottom. Upon the latter are fixed curved wooden blocks upon which amalgamated copper plates forming the cathode are disposed. Between each plate is a groove containing mercury, while between the adjoining cathode plates of two sections is a well containing mercury, but not connecting together the adjacent plates. Each section is connected up to cross conducting-bars leading to a main conductor. Along each side are fixed strips which support convex plates, preferably lead, forming the anodes, shaped so that the outlet for the electrolyte and ore is contracted. The anodes are connected by conductors on the vertical partitions to a main tubular conductor, which is held securely in recesses in the partitions by a fixed bar and a removable bar. The latter is connected by a spring to the main conductor. The gold and other metals are deposited during the passage of the electrolyte and ore through the inclined sluice, the peculiar form of which tends to keep the electrolyte well agitated, and the electrolyte so decomposes and recombines in its passage that it is suitable, after separation from the tailings, for re-use. 16 claims.

28,157. "An improved form of relay applicable to pneumatic or electric organs, or to other apparatus." R. Hope-Jones. Dated November 30th, 1897. The invention relates to a form of relay application to organs and other apparatus where a movement, started by hand, is completed by electric or pneumatic agency. A wind chest containing air under pressure communicating by a port with a bellows, and by a second port with a second bellows is described. The ports are controlled by valves on a rod connected by a friction clamp with a key. On depressing the outer end of the key, the first port is opened to the atmosphere, and the second port to a chest. The remainder of the motion of the key is thus effected by the bellows. The movement is reversed by slightly raising the key. 5 claims.

28,246. "An improvement in safety electric fuses." H. C. Govar and W. Muller. Dated November 30th, 1897. The base is formed with slots adapted to receive sliding inverted T pieces carrying the terminals to which the wires are secured. The wires pass in through holes and are secured by screws, and the fuse wire is threaded through a tunnel and secured by screws. Slots are cut in the screw thread, and communicate with a groove which is in communication with the exterior through openings. 3 claims.

30,037. "Improvements in electric arc lamps." D. Lacko. Dated December 18th, 1897. (Date claimed for under Patents, &c., Act, 1883, Sec. 103, July 21st 1897, being date of application in France.) Relates to arc lamps. The carbons are carried by angular supports sliding in tubes and hung by a wire cord from a V-grooved pulley, the upper support being heavier. Each support carries fixed and movable grooved jaws, which are closed on the carbon placed between them by turning an oval ring surrounding them by a handle until a projection on the fixed jaw engages in a recess in the ring. The ring is held in place by a flange on the fixed jaw. The upper holder is insulated from its support. The groove of the pulley receives a wedge-shaped brake-block, pivoted to a support, which is pivoted and pressed by a spring against an adjustable loop on a regulating lever. This is bifurcated and pivoted to supports at each side of the pulley, and is pressed up against a screw-stop by a spring. It is linked to a core, which slides into a shunt solenoid to an extent limited by a stop. Increase of the pressure across the carbons causes the core to descend, and the brake to release the pulley, allowing the carbons to feed together; in starting, the release of the core when the carbons touch, allows the spring to raise the lever, the brake-block then engaging and turning the pulley, the arc being thus formed. 4 claims.